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THE ACETYLENE SCARE.

In referring to this new rival of the electric light in our issue of Feb. 16, we stated, in reference to the estimated cost of its production, that until the figures given are substantiated they need not worry the managers of electric light stations or those who install and manufacture electric lighting apparatus. The figure at that time was about $15 per ton of the calcium carbide from which this gas is produced. It now appears that the lowest price at which the material may be purchased is 8 cents per pound in 20-ton lots, the price in one-ton lots being 12 cents, which figures are equivalent to $160 and $240 per ton respectively. In addition there is a considerable expense for the water-tight drums in which the carbide must be packed for shipment. As the margin between these actual figures and the theoretical price is so very great, those interested in electric lighting may again sleep in peace.

GALVANOMETER CONSTRUCTION.

In another column we print an article from the pen of Prof. Fisher describing the construction of a simple type of galvanometer. A large number of these instruments was made at Lehigh University, and gave results that, as will be seen from the comparison with commercial instruments, were remarkable when we consider that all of the work was done by students almost entirely unskilled in the processes of construction. Working drawings, as well as full and explicit instructions, are given in the article, and the opportunity thus presented to the amateur who desires to construct a galvanometer is an unusually favorable one, as it rarely happens that the necessary directions for making apparatus of scientific accuracy are placed within his reach. Most of the parts of the instrument can be easily made by the amateur; in the lack of a lathe, such parts as require its use could be made by almost any instrument maker or machinist from the drawings, and the mirrors could be purchased from a commercial maker of instruments if preferred.

THE BUFFALO-NIAGARA FRANCHISE.

After unusually protracted consideration, the committee of Buffalo municipal officials having in charge the matter of fixing the terms of a franchise under which the Niagara Power Company would be permitted to do business in Buffalo, has rendered its report, a résumé of which we print elsewhere. The three principal points in the report are those concerning the supply of power for municipal purposes, the terms under which power is to be supplied to private users, and the provision in regard to the Niagara Company providing additional and equal facilities with respect to poles and conduits to accommodate two other prospective competing companies. The provisions concerning the sale of power for municipal purposes and the free use of poles and conduits for municipal lines include compensation for the franchise, and therefore are to be considered only in this connection. The provision requiring the Niagara Company to provide pole and conduit facilities for each of two other companies equal to those necessary for its own needs, was doubtless designed to avoid a similar experience to that of New York City with respect to its subways. While the requirement is an onerous one, yet the Niagara Company would seem to be in a position to have little or no fear of any prospective rival profiting by the terms of this section. After all of the talk in regard to the municipal authorities fixing limiting prices at which power should be sold, it is gratifying to learn that they have left this matter to be settled between the buyer and seller, the only restriction being the very fair one that there shall be no discrimination between users. The report has not as yet been acted upon by the City Council, but it is not believed that its provisions will be materially changed upon

final adoption. It is quite possible, however, that the Niagara Company will require some changes, as thus far only one party to a proposed contract has had a voice in the preparation of its terms.

PREVENTION OF ELECTROLYSIS BY TROLLEY CURRENTS.

In another column Mr. Stuart-Smith gives some very strong reasons in favor of the method proposed by him for the prevention of electrolysis and consequent corrosion of underground piping by trolley currents. This method consists, as will be seen from the article, in connecting the track to underground piping at frequent intervals, and commencing at a point distant from the power house where the pipes first become positive to the track. A hasty reading of his article led us into error in regard to some points of the proposed method which, as remarked by Mr. Smith, would relieve the piping through a metallic connection of the current flowing into it, instead of the reverse, as stated by us. It should here be remarked that all of the various methods that have been proposed for the protection of piping rest upon an assumption that the difference of potential at a given point between the piping and the track is a constant, which necessarily cannot always be the case, depending as it does upon the relative position of the cars on the line, and the position of a single car relative to a given point on the line. As a consequence of these considerations, there are probably some points of a line where the potential changes sign at intervals, and to meet this case the method of Mr. Smith seems to be particularly applicable, especially if the system of connections proposed were carried to the farthest point where such a change might be expected. In this case the surgings of current would take place through local metallic circuits instead of otherwise causing electrolysis when the piping becomes positive.

SIZE OF STEAM UNITS IN CITIES.

Some data recently published as to the size of steam units in Paris and Berlin are interesting as bearing on the subject of the electrical transmission of power. Within the walls of the former city the aggregate horse power of the stationary steam engines in use exceeds 55,000, and the average horse power is only slightly above 17, there being over 3,200 engines in use. In Berlin and suburbs the aggregate horse power is in the neighborhood of 58,000, the average horse power of the engines being 38. The largest average size of engines in any of the manufacturing districts of Prussia is less than 100 horse power, and averages of above 50 are confined in general to mining, iron working or other heavy manufacturing districts, the units in cities being small. We regret there are no corresponding data at hand for American cities, but there is no reason to believe that the conditions in these with respect to the size of units are materially different. We have before referred to the absurdity of estimating the charges for electrical power on the cost of steam power generated in exceedingly large quantities, and the above figures bear us out if, indeed, any specific evidence were needed in such a palpable case. While the central lighting and power stations and perhaps a few of the largest industries in a city will be customers for electrical power in large quantities, the most profitable portion of the business will be in the supply of power in small quantities, and for this a rate that should be entirely satisfactory to users would be nearer $75 than $30, the figure usually referred to in discussions on the subject.

THE ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

We print in our financial department the third annual report of the General Electric Company, which enables some idea, though not a very satisfactory one, to be formed of the condition of that company on Jan. 1 of the present year. The most favorable features of the report are the showings of business done during the year, the decrease in expenses, and the great reduction of the floating debt. As will be seen by reference to the balance sheet, the sales amounted to over twelve and one-half millions, and the total receipts, including royalties, sundry profits and returns from securities owned, aggregate over thirteen millions. The gross profit on this business was $1,811,747.60, against which there are charges of $932,521 for old losses, depreciation of inventories, cost of patents and franchises acquired, and sundry losses—the latter amounting to $38,798. As the two former items are due to specia circumstances, and the third would not customarily come out of the profits of business, the amount of profits that would ordinarily go toward paying dividends is $1,308,365, or sufficient to pay about 3¼ per cent. on the $34,712,000 of capital stock. The unfunded debt of the company, which was $599,505 at the end of 1893, has been reduced to $90,021, and the liabilities for paper endorsements and discounts, which were $2,022,454 last year, have been entirely discharged. While the showing is undoubtedly favorable thus far, and reflects credit particularly on those in charge of the manufacturing and commercial departments, there are some unfavorable features to be considered. The shrinkage of assets has increased from $12,454,967 to $14,794,716. The two items of notes and accounts receivable ($6,550,499) and stocks and bonds ($5,079,-012) are so indefinite as to offer little assurance as to their real value, while the figures given for the plants and inventories are largely fictitious in the absence of any purchaser for the former, and in view of the rapidly changing value of the latter, both in price and marketability. Perhaps the most unfavorable feature is the valuation of patents, which is placed at the same figure as in 1893, $8,159,265, notwithstanding the loss during the last year of three of the most important patents held—those on the incandescent lamp, the feeder-and-main principle and the Thomson arc regulator. The conclusion we believe an examination of the report will lead to is that a company which can, under adverse circumstances make the showing the General Electric Company has in volume of legitimate business and in manufacturing profits, deserves to be placed on some other basis than one which the most herculean efforts would not seem to be able to make secure. As we remarked before, the result of the year is extremely creditable to the technical and commercial employees of the company, but it is not creditable to those controlling its financial management that no steps are taken in the direction of a reorganization which would make such a good showing count on the side of a real prosperity.

Hydraulic Power Conduit at Buffalo.

The conduit for the wires of the Niagara Falls Hydraulic Power & Manufacturing Company is nearly completed on the north side of Falls street, Buffalo. This company owns the power canal and is a competitor of the Niagara Falls Power Company. The canal is large enough to supply turbines up to a total of 100,000 hp. The power conduit consists of an iron pipe eight inches in diameter which has within it several ducts for the conductors to pass through. The conduit is placed three feet below the surface of the street.

The widening of the power canal of the Niagara Falls Hydraulic Power & Manufacturing Company is progressing finely. A large strip on the east side of the canal near the Erie avenue bridge is now being removed.

Accumulator Traction in Paris.

At the April meeting of the Société Internationale des Electriciens, M. Sarcia gave some information in regard to results obtained with the three storage battery lines established in Paris since 1892. In 1892 the mileage was 145,000 miles, and the expense per car mile 20.6 cents; in 1893 the total mileage was 502,860 miles, and the cost 16.7 cents per car mile. Among recent improvements made to facilitate the handling of the storage batteries, the latter, instead of being placed under the seats as formerly, are now contained in a box which is suspended underneath the car between the two axles. It is hoped by this means to reduce the expense to 14 cents per car mile.

The Buffalo-Niagara Transmission Line.

A Buffalo newspaper reports that the Niagara Falls Power Company has made a proposition to the New York Central Railway Company to furnish power for the electric cars it is proposed to run on the line of the latter company between Niagara and Buffalo, in return for the use of an unoccupied strip of land along the tracks for the installation of electrical transmission conductors.

The Buffalo-Niagara Franchise.

The report of the committee of Buffalo municipal officials appointed to consider the terms under which a franchise would be granted to the Niagara Power Company for the right to do business in Buffalo, was submitted on April 26, and we give below a resume of the various sections of which there are 16 in all. The report will not be considered by the Council until May 20.

Section 1 requires that plans and specifications of all proposed pole lines and conduits shall be filed with the Board of Public Works, as well as specifications relating to material, methods of insulation, etc., and that work cannot be proceeded with until authority has been granted by the Council after approval by such board.

In section 2 it is required that all poles erected and all conduits laid shall be of sufficient size and capacity and of such construction as to afford facilities for at least two other companies, each requiring facilities as great as the company receiving the grant, which additional space may be used by the city for any public purpose without charge. Any other companies not exceeding two, upon receiving substantially similar grants from the Council, and on making compensation for the use of such poles or conduits, may use the same for similar purposes to the extent of the space and facilities not used by the city; the compensation to be fixed by arbitrators should the companies concerned not agree as to the amount. The poles and conduits shall also be of sufficient additional capacity for four wires each of the Fire Alarm Telegraph and Police Signal System, for which there shall be no charge.

In section 3 it is provided that all work shall be under the immediate direction and supervision of the Board of Public Works and such inspectors as it may appoint, and the same authority may at the expense of the company at any time do all the work necessary to restore to a proper condition any street left in a state dangerous to life and property.

The fourth section stipulates that in case the company fails to use all necessary measures to avoid danger to life and property the Board of Works may furnish the material and do the work necessary to that end at the expense of the company. The fifth section requires that the company shall at its own expense make any changes in conduits or lines necessary in carrying out any public improvement by the Board of Works. Section 6 requires the company to put its overhead lines underground whenever demanded by the city authorities. Section 7 permits the use of poles and conduits of any electrical company having a similar franchise to the one in question upon just compensation. Sections 8, 9 and 10 are of the most interest, as they relate to the terms of sale of power. In section 8 it is provided that the company shall, during the entire period on the grant, supply electricity to such extent as the capacity of its plant and its facilities for increasing the same will permit, to all persons and corporations desiring the same in Buffalo City and situate along any of its lines of transmission or within five blocks thereof, upon their complying with such general rules and regulations not inconsistent herewith as it may make with respect thereto; and shall not charge therefor a greater price than it shall charge other consumers in Buffalo for the same or a less quantity of electricity supplied the same or a greater distance from a distributing station, and shall not charge any consumer a greater price than it shall have previously charged him, or a greater price than it shall charge consumers at other points further from its Niagara Falls power house for the same or a less quantity of electricity supplied the same or greater distance from a distributing station. Whenever said company shall have received bona fide applications for power aggregating 1,000 hp within a radius of a mile from any point in any part of the city, where it has not constructed a line of transmission, and the applicants shall have tendered the said company contracts for the use of power, aggregating said amount, for at least one year, accompanied by a bond, which contracts shall conform to said company's general rule and regulations not inconsistent therewith, then and in such case the Common Council may order and direct the company within six months thereafter to extend its line of transmission and furnish electricity to such applicants so far as the capacity of its plant and its facilities for increasing the same will permit.

Section 9 provides that the company shall agree to supply the city with electric power for its water works or other public purposes at a rate not exceeding $20 per horse-power per annum, 24 hours a day, and for lighting the public streets, avenues, alleys and places of the city at a rate not exceeding $50 per annum for each electric light of 2,000 cp, or to supply such electricity at the city line to any contractor for lighting the city at a rate that will enable such contractor to contract for lighting the city with lights of said candle power at a rate not exceeding $50 per annum for each such light; provided, however, that where the city shall require power at points not on a line where the company is supplying electricity to others, it shall pay the extra cost of transmission.

Section 10 requires that the company shall be prepared to supply 10,000 hp to consumers within the city on or before the 31st day of December, 1895, and 10,000 additional horse power within each successive year thereafter for four years, so far as the demand therefor may require the same.

Section 11 makes the term of the grant 25 years, at the expiration of which time the city may purchase all parts of the plant within the city limits at a price agreed upon by three appraisers, one to be appointed by the company, one by the mayor and the third by the two thus appointed. In case the city shall not give the company one year's written notice before the expiration of the grant of its election to purchase the plant, the grant shall be renewed at the request of the company for the same term of years or such longer time as the Council may authorize.

Section 12 specifies that the grant is not transferable or assignable without the consent of the Council, and that the company shall not consolidate or merge with any other company or corporation, or enter into agreement to prevent competition, or the reduction of the price of electricity, without such consent.

Section 13 requires a bond of $250,000, and provides that the company shall pay all expenses incurred by the city in supervising any work done under this grant.

Section 14 is in regard to obtaining consents for tearing up pavements whose maintenance or repair is at the charge of private citizens. Section 15 specifies penalties for the violation of any provisions of the grant, and section 16 requires a written acceptance of all its terms before it shall become operative.

The National Electric Light Association.

A meeting of the officers and executive committee of the National Electric Light Association was held in New York, on May 4, to discuss matters in connection with the time and place of holding the next annual convention. All of the officers of the association and all but one member of the executive committee were present, as follows: President C. H. Wilmerding, Vice-Presidents Frederick Nicholls and E. F. Peck, Secretary and Treasurer Geo. F. Porter, Master of Transportation C. O. Baker, Jr., and Messrs. John A. Seely, E. H. Davis, A. J. De Camp, C. R. Huntly, W. W. Carnes, W. R. Gardener, G. A. Redman and J. J. Burleight, of the executive committee. In addition to the above, several representatives of electrical commercial interests and of the electrical press were present by invitation, in order that an expression of opinion might be obtained from them in regard to the questions discussed.

An extended discussion took place on the subject of annual meetings, and the sense of those present seemed to be in favor of a proposition made to the effect that, hereafter, meetings should be held alternately in New York and Chicago, and at the entire expense of the association. Some opposition was manifested in regard to holding exhibitions in connection with the meetings, but most of those present who spoke on the subject declared themselves in favor of having such exhibitions as part of all future meetings.

It was proposed that the next meeting be held at New York, in May, 1896, and that an extensive electrical exhibition in the Grand Central Palace be organized in connection with it. This proposition seemed to meet with favor, and after some discussion the following named gentlemen were appointed a committee with authority to decide upon the date and place of the next meeting, and whether an exhibition shall be held in connection with it: Messrs. Wilmerding, Nicholls, Peck, Huntley, Seely, De Camp and Porter.

Electric Traction in the Isle of Man.

The electric railway to the top of Snaefell, Isle of Man, is being rapidly pushed on, and it is anticipated that the line will be completed in time for the coming season.

Effects of Competition.

A firm in Germany sells incandescent lamps at a little less than 14 cents each.

The Governing of Steam Engines.

Mr. G. L. Addenbrooke, in the London *Electrician*, gives an account of some experiments on the engines of an electrical plant in India for which he was the consulting engineer.

The plant consisted of three 40-kw dynamos, coupled direct to Belliss compound engines; the boiler pressure was 120 pounds, and the speed was to be under 525 revolutions full load; the dynamos were fully compounded. The compounding having been adjusted on the first set, and trials of this and the second set having established the characteristics and working of the plant, advantage was taken of the trial run of the third set to make the experiments on the governing and control of the engine, after the plant had run for about four hours at full load, viz., 100 volts, 100 amperes and 500 revolutions. The experiments were as follows:

1. The whole current was suddenly switched off, leaving no load on the engine. The speed at once went up to something over 600 (the tachometer was not calibrated further), but within a second it was reduced to 575, and after two more oscillations of rapidly-decreasing amplitude, and taking only a few seconds, the engine settled down to run steadily at a speed of not more than 1 per cent. difference from the full-load rate. This was repeated, and the current then switched on.

2. The governor (of the throttle-valve type) was kept full open, and the speed run up to 575 revolutions, when the dynamo gave 403 amperes at 118 volts. The engine was then doing 18 per cent. more than its proper load, or about 80 hp. It still ran quietly, and the governor seemed to have proper control over it.

3. An attempt was next made to ascertain the sensitiveness of the governor to slight differences of adjustment, which are obtained by means of a small hand-wheel working on a screw; this alters the tension of a spring, the latter balancing the thrust of the governors, the action of which opens or closes a sensitive throttle-valve arranged in the main steam pipe.

In the first pace, the load was reduced to a quarter, and when everything was running steadily, a complete turn of the governor adjusting wheel was made. The result was to reduce the revolutions about 12, and to bring down the voltage 3 per cent. Under the same circumstances, a half turn made about five revolutions difference in speed. The difference made by one eighth inch of a turn was not sufficiently decided to be observed, but a one-fourth inch turn was; and it was clear that the voltage could easily be regulated within less than 1 per cent. or a one-third inch turn, by means of the governor. In the next place, the full load was put on, and the above experiments repeated, to see if the governor was as sensitive at full as at one-quarter load. Under these circumstances a whole turn of the governor adjustment wheel reduced the revolutions by 14, and the voltage in two trials, both up and down, was increased and decreased by 3 per cent., in accordance with the direction in which the turn was taken.

4. The plant running full load, by rotating the adjusting wheel the speed was lowered 20 and 30 per cent. while the engine was running, and afterwards brought up again to the normal.

Of course, in trials like these, involving small differences, slight alterations of pressure in the boiler, the cooling and heating of resistances, and other matters, a very high degree of percentage accuracy is only attainable by extreme care and careful preparation. But the above results are sufficiently accurate for all practical purposes, and the observations left the impression that, if possible, even better could have been done after the engine had had two or three weeks' constant work, and all the working parts had become properly polished.

It is worthy of note that the engine, which indicated some 65 hp during the trials, was placed on a platform, and was not bolted down—simply standing on its own extended bed-plate.

Mr. Addenbrooke concludes that the makers have certainly used great care and skill in working out their engine, with the most excellent results. His account of these trials, he states, is not to eulogize the engine beyond expressing a high opinion of it, nor does he suppose that they are unique in their method of governing. The object has been to show that engines can be made to govern, and with provision for altering the adjustment of the governor or the speed of the engine, over the full range required for central station or similar electric work; and that the governor can also be made sensitive enough to enable sufficiently accurate increments or decrements of voltage to be provided for by adjustment of the governor, and thus that it is thoroughly practical to provide the voltage required in the omnibus bars and in the circuits by adjustment of the engine, leaving the switchboard attendant to his proper duty of observing the voltage in the feeders and at the feeding points or transformer stations, which he is then in a better position to keep at the requisite pressure than if he had to look after the adjustment of exciting resistances also.

Electrical Engineers.

What to do with mothers' sons, says the London *Electrician*, is becoming a more and more important problem every day in the households of the United Kingdom. A profession that has few prizes and many blanks, especially when the prizes themselves have no very great attraction, does not attract the best men. It may be that it contains openings for hundreds, if not thousands, of units, but few of these units come in prominence because of talent. The electrical engineering professsion is such a one. It employs many men, most of whom are mere items, and will remain items to the end. These items are intensely ignorant of the why and wherefore of their everyday work. Their only view is bounded by the wall of as much pay as possible and as little work as possible. Their ignorance compels them to wait for assistance at the rise of every little difficulty. We should prefer to see more men ready to grapple with the difficulty and capable of stepping into a higher position when the chance offers. When the standard of knowledge in any profession is of a high order, wages and salaries also average higher in amount, because the universal law of supply and demand acts in this direction. The most recent development in the electrical industry seems to warrant the conclusion that in future the number of prizes will be greater, and this will lead to greater competition for such prizes and inevitably to a higher standard of knowledge in certain ranks of the profession. Hitherto putting aside the question of consulting engineers, with which we are not now dealing, the best positions open to general competition have been those of municipal electrical engineers. The renumeration, except in a few cases, has however been too low, but this may probably have arisen from the youth of the profession. No one in the earliest days could adequately grasp the value of the work to be done, and municipalities were cautious in offering too much. As time went on, it became clear that to successfully manage a central station demanded capacities of a much higher order than were originally thought necessary. In more than one case success has been taken as obtained automatically, but the illness or departure of the successful organizer has opened the eyes of those who controlled the management. It is an open secret that some companies have found the loss of a man of far greater importance than they ever suspected. We, however, have no intention of dilating further upon the settled conviction of business men, that the proper course to pursue is to employ those who know their business, and to pay them well for their work. Experience is only gained by age, and experience is worth paying for.

What Next?

The latest sensation which the public is expected to swallow is a story now being circulated by the daily press to the effect that there lives near Abilene, Tex., a young woman whose hair might become of practical use should electrocution be adopted by her State. The story has it that this remarkable hair sweeps the floor as the owner walks, and gives forth crackling sounds along with a strange, weird light at night. If it stopped at this uncanny manifestation all would be well, but we are assured that a person touching a strand of the hair receives a terrific shock, and that a young physician who investigated the matter is nearly dead, as the result of his temerity and skepticism.

The girl, it is said, discovered her peculiar power recently, when, in bending over to caress a kitten, her hair fell about it and killed it instantly.

Farragut and Sumter.

At the recent meeting in Washington of the Telegraphic Historical Society, Mr. Henry A. Reid related that he received the news of the firing on Fort Sumter in the Poughkeepsie office, while Commodore Farragut, who was visiting friends in that city, stood beside him and read the message as it was written down. When the message was concluded Farragut remarked: "That means I must go to Norfolk at once. I have many friends there, but if duty requires I will blow the city to h——l."

An Electrical Ferry Service.

BERGEN, Norway, enjoys the distinction of having the first electrical ferry service in the world conducted as a business enterprise. Primitive rowboats had for a long time been adequate for the increasing traffic between the different sections of the city, and after a consideration of steam, petroleum and electric boats it was finally decided that the latter possessed the greatest merit for the use proposed.

The ferry plant consists of eight boats, a charging station and a boat harbor. Work was begun last May, and by August the ferry was started.

Fig. 1 gives a view of one of the boats, and their construction is shown in Figs. 2 and 3, the details of which were determined by

FIG. 1.—ELECTRICAL FERRY BOAT.

the requirements of the ferry service. The dimensions of the boats are as follows:

Extreme length	26 feet 3 inches.
" breadth	6 " 7 "
Draft (about)	2 " 7 "
Number of passengers	18
Displacement	6 tons.

The boats are built symmetrically fore and aft and provided with a screw and rudder at either end in order that turning when leaving the landing places may be avoided, that they may be more easily

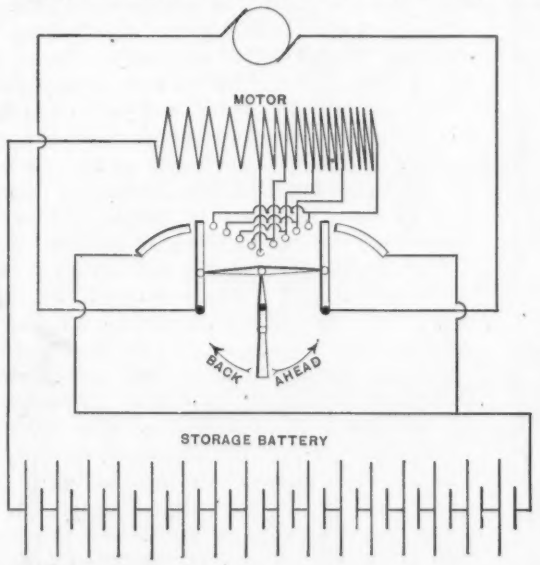


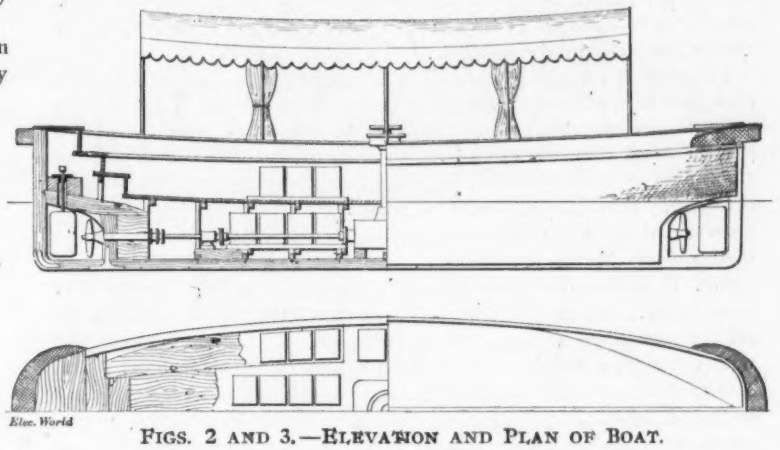
FIG. 4.—DIAGRAM OF CONTROLLER CONNECTIONS.

steered and for other reasons. The screws are on a common shaft, direct coupled to the motor.

A series-wound motor is used, weighing about 660 pounds, and rated at 3 hp; it is placed in the middle of the boat under the flooring. Its construction is such that the insulation cannot be injured by any bilge water which may collect. The radically fastened carbon brushes work without sparking or heating of the commutator, whether the armature is turning forward or backward.

The storage batteries are placed partly under the flooring and partly under the seats, as can be seen in Figs. 2 and 3. The plates are of the Hager type, and those of each battery weigh about 3,080 pounds, and have a capacity of about 20,000 watt-hours. The battery consists of 32 cells in series, and weighs altogether 5,280 pounds.

In order to control the speed, a special switch (Fig. 4) is provided, which operates by cutting different parts of the field coils of the motor in and out, and so causes the boat to go ahead, astern, slow and faster by regular gradations. In the middle of the boat, over the motor, there is a cylinder, about four inches in diameter, through which pass the conductors to the motor and the accumulators, and the connections to the steering apparatus. On the head end of this cylinder are two wheels, each 16 inches in diameter, placed one above the other, the upper of which works the rudder, while the lower controls the movements of the regulating switch.



FIGS. 2 AND 3.—ELEVATION AND PLAN OF BOAT.

The average speed, with a power of 2,300 watts, is about five miles an hour. As the distances between the landing places (Fig. 5) are not great, this comparatively low speed has been found ample, and owing to the crowded condition of the harbor, it is even necessary in order to avoid accidents.

The bearings of the motor and the shaft are self-lubricating while running, so that the man at the wheel, who operates the boat alone, can give his individual attention to steering it. The boats are run under five minutes' headway and from 7 o'clock in the morning to 9.30 at night in the winter, while in summer the daily service is lengthened. Each boat runs about 37½ miles a day. Up to this time about 1,800 passengers, on the average, have been carried by the ferry each day. After the day's work is over, the boats return to the charging station, where the accumulators are charged during

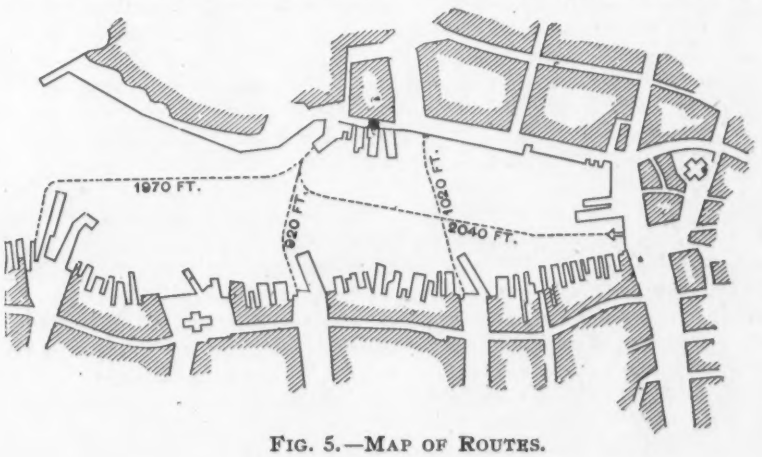


FIG. 5.—MAP OF ROUTES.

the night, and the necessary cleaning done and repairs made. The charging station is fitted with a compound portable steam engine, a dynamo of 30 hp and a suitable switchboard.

The total cost of the plant was as follows:

Eight boats, including duplicate parts	$11,900
Charging station, boat harbor and landing places	9,520
Total amount	$21,420

During eight months of uninterrupted operation the plant has proved excellent in every respect.

The above description is borrowed from an article in the *Electrotechnische Zeitschrift*, written by Mr. J. Trumpy, of the Bergens Elektriske Faergeselskab, who designed the boats and plant.

Galvanometer Construction at Lehigh University.

BY EDWIN E. FISHER.

During the fall of 1894 a piece of work well worthy of note was undertaken by the Junior Students of the Department of Electrical Engineering at Lehigh University. The work consisted in the construction of a set of galvanometers for use in the laboratory, and derives its interest from two sources: First, in that a body of students, almost entirely unskilled in construction work, built up a set of instruments which for accuracy, sensibility and finish stand very close to instruments put forth by our best manufacturers. Second, in that this set of instruments shows to a certain extent the amazing results which may be obtained by the new method for astaticizing galvanometer needles, as advanced by Mr. F. L. O. Wadsworth, in the November issue of the *Philosophical Magazine* for 1894. Covering, as this set of instruments does, such a wide range, the results are particularly valuable.

To meet the varying work of a laboratory, the instruments were designed of resistances ranging from 160 ohms to 5,000, giving instruments suitable for most of the general work which students meet. Also, they were designed so as to produce instruments which should be both serviceable, reliable, and at the same time highly sensitive. How nearly these requirements were met can best be ascertained by a careful consideration of the details of one of the instruments given later.

Fig. 1 shows the general appearance of the instruments after completion. All the different designs are here shown (though not all the instruments, as there were three or four of some of the types) with both front and back of each type where possible. Figs. 2 and 3 show to somewhat better advantage two of the most satisfactory of the designs, Fig. 2 showing the high resistance potential instrument, with the cups on and off; Fig. 3 gives a similar view of the two-coil instrument.

The table near the end of this article gives results of the tests made upon completion. The first three instruments, *a* 1, 2, 3, are by one of our best American instrument makers and merely inserted for comparison and reference. Instrument *a* 1 was an excellent example of fine work, being of the *best* construction mechanically and electrically. Its sensibility, as given, needs no comment (the controlling magnet not used). The remainder of the list gives the details of the instruments constructed. As will be seen, there are three instruments of about 5,000 ohms, two of 4,000, nine of 400, and one of 160. The magnetic systems of all are astatic, vary in weight from .4 to .6 gm, and in number of needles from 68 to 12. All sensibilities given in this table are for the instruments under the earth's influence only, and *not* using a controlling magnet.

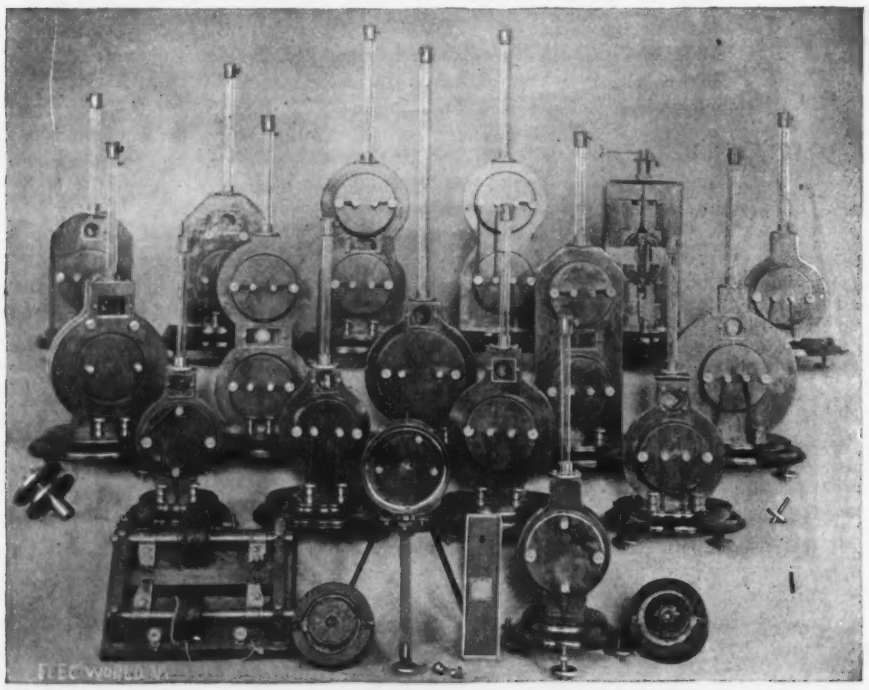
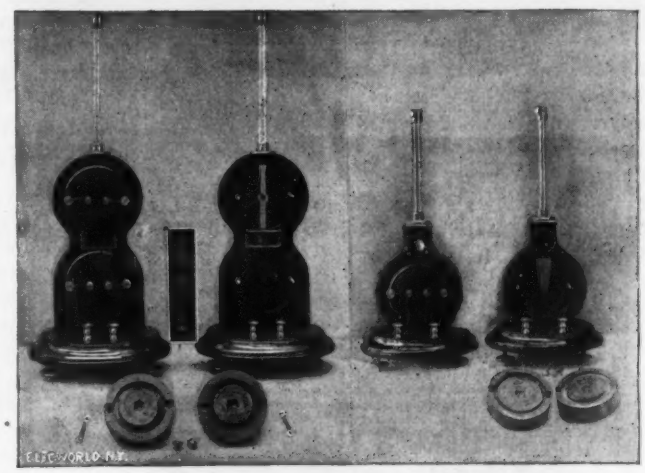


Fig. 1.

The most sensitive instrument (*b* 1), it will be noticed, has a sensibility of 12×10^{-11}, which is about *two-thirds* the current necessary for the instrument (*a* 1) of standard manufacture. When one stops to consider that *b* 1 is nearly 800 ohms *less in resistance* than *a* 1, and uses *silk* instead of *quartz* for its suspension, certainly the result is well worth notice. This, without doubt, was due primarily to the method of magnetizing the needles. Indeed, when properly made the needles would become so nearly astatic that the earth's influence *was entirely null*, and only the torsion in the silk suspension fibre affected the position in which the needles rested.



Figs. 2 and 3.

The instrument *a* 1 is not an old one, being out of the manufacturer's hands less than six months, but its magnetic system was probably built up after the old methods; were it to be reconstructed and remagnetized according to the newer method its sensibility would probably be most surprisingly lowered. (The sensibility given for this instrument is that given by the manufacturer's test.)

Instrument *b* 1 was first tested with a magnetic system having but 14 needles, giving a sensibility of 62×10^{-11}. This system was then reconstructed, using a better grade of steel and 68 needles, which change reduced the "figure of merit" to *less than one-fifth*. Thus *b* 2 and *b* 3 would probably give equally good results were they treated in the same way. The remainder of the instruments, it will be seen, give sensibilities which are quite remarkable, and yet were they to be reconstructed, using the better steel, and greater number of needles, one could predict sensibilities one-fourth or one-fifth the present, at least. Especially would the effect be great, as these instruments have so small a number of needles (12).

The construction of all the instruments can best be shown by carrying through in detail the construction of one certain instrument, as all were built upon the same principles; the woodwork of all was the same, except in design and dimensions; the coils of all were graded and of the dimensions given by Mr. Edwin F. Northrup in The Electrical World of November and December, 1893; the needles of all were astatic, built up similarly, and all magnetized by the method previously stated; the metal parts of all were the same. For this purpose, that instrument which has been most nearly perfected, *i. e.*, *b* 1, is taken.

The wooden framework of this instrument is shown in detail in Fig. 4. Here it will be seen that the frame consists of two parts: the base, and the upright section which is firmly attached to it. This upright part is composed of three pieces firmly glued together, the object being to prevent any change in the instrument due to warping, and also to form by the thin "separator" (middle piece, 3-32 inch thick) a rest or stop for the coils. This middle strip is almost entire, being cut away only enough to allow the needles to swing freely. The coils are thus kept always at the distance apart of 3-32 inch. An upright thus made, and of well seasoned material, should warp very little, if at all. The distance between coils might be made less, but would hardly be advisable unless metal were used.

The cups for receiving the coils are as shown, and are not quite deep enough to allow the coils to sink below the flush surface. In this way the wire always touches the separating strip of wood, and is as near the needle as is allowable, producing the maximum magnetic effect under the circumstances. The cups are held to the woodwork by four threaded brass rods (not shown) which pass through the "separator" and have thumbscrews at their ends. The terminals of each coil are taken to two small binding posts on the exterior of the cup, these posts being finally properly connected to each other and to the main binding posts of the instrument. The drawing shows arrangements for the damper and for a window to allow access of light to and from the mirror. This window is closed by a piece of plate glass held in place by screws. A piece of sheet rubber between the glass and the wood prevents air entering due to any poor fit or uneven woodwork.

Fig. 5 shows such metal parts as are necessary.

The leveling screws need no comment and are placed as ordinarily upon such instruments.

The suspension tube is clearly shown, having two points worth

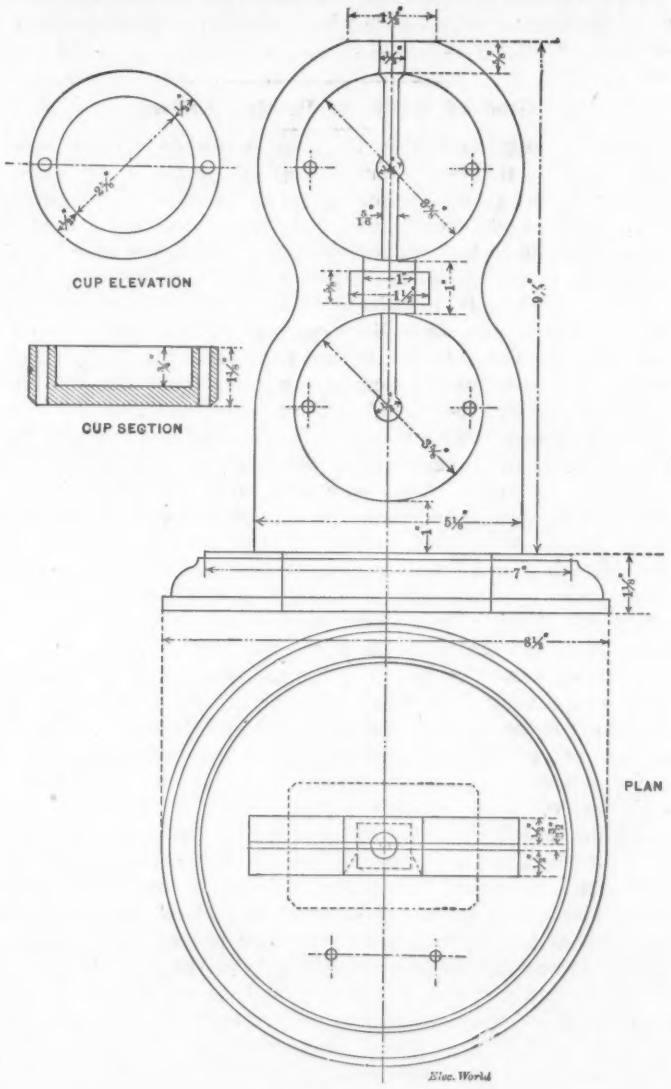


FIG. 4.

mention. The "head" is so arranged that an *indefinite* length of silk fibre may be taken up, yet always maintaining the central position. Also should this rolling of the fibre produce torsion it may be immediately removed by turning the "head" upon the glass tube, rendered possible by the strip of chamois interposed between the brass cap and the glass tube. This chamois is shellaced to the glass, but *not* to the cap, and keeps the "head" perfectly tight, true, and vertical, yet free to move (though snugly) about a vertical axis. The lower end of the tube may be held in the "base" either by chamois, which answers admirably, or by sealing wax or plaster of paris. Naturally, an instrument of so great delicacy would be positively worthless were it not for this "torsion head" which allows the perfect removal of any torsion which may be in the fibre.

Between the metal base and the wooden framework a piece of felt is interposed. This is in the form of a circular disc (cut away at the centre to allow passage for the suspending fibre) of about 1¼ inch diameter. This felt answers two purposes: it serves to prevent air currents passing through and disturbing the action of the needles, as the wood and metal could not otherwise be made to fit perfectly; also it serves as a means for adjusting the suspension tube into a perfect alignment with the rest of the instrument (the position of the tube being changed by tightening or loosening the screws holding the tube base to the frame; the felt being elastic gives much play).

The most important part of the instrument is its "astaticized needle system" or magnets. This instrument was first constructed with its magnets of the dimensions as in Fig. 5, but using 14 needles, instead of the 68 shown. At first only two mica discs for needles were used, one at the top and the other at the bottom, the needles being placed on the one side only. With this arrangement the sensibility was 62×10^{-11}. Reconstructing this system, using a mica disc on either side of the glass fibre at the top and at the bottom (*i. e.*, four discs in all) it was possible to use 68 needles, with which the sensibility obtained was 12×10^{-11}. In this last case, the needles were made of No. 8 guitar string, tempered glass hard. This steel is not the best that may be obtained by any means, so that even this remarkably low sensibility might easily be lowered still further.

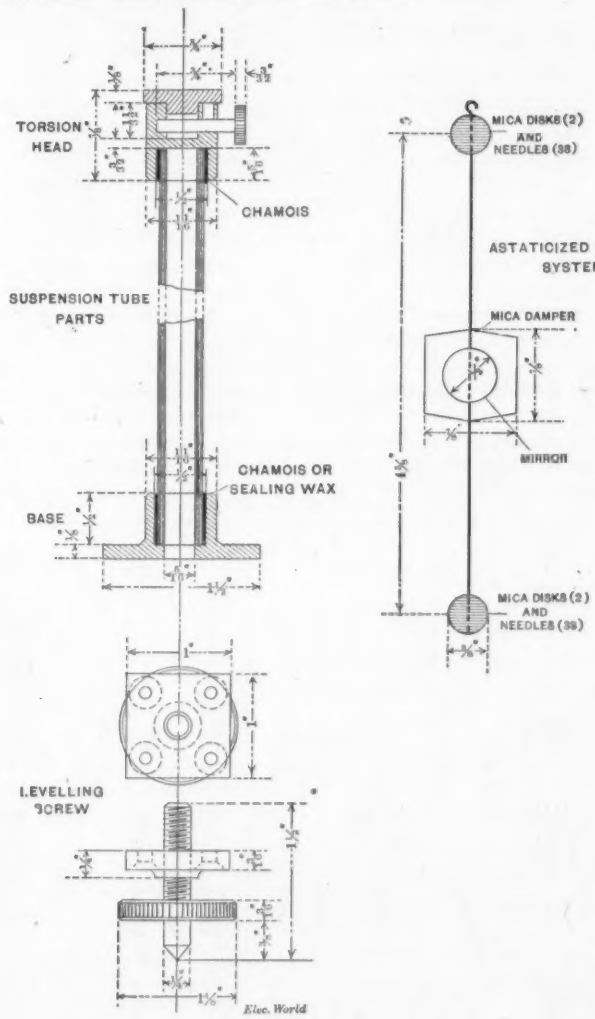


FIG. 5.

Glass was used to hold the discs, mirrors and damper together; quite inferior to quartz, yet answering fairly well. The small hook at the upper end, for attachment to the suspending fibre, was of No. 38 B. & S. copper wire firmly held with sealing wax. Shellac was used for holding needles and discs in place.

The mirrors used were of "home manufacture," and hence not of the efficiency which might have been wished. They were made by depositing from solutions metallic silver upon thoroughly cleaned microscopic "cover glasses." Great care and close inspection had to be exercised in choosing the mirrors to be used, yet the final result was quite satisfactory. The mirrors were perfectly plain, being suited from their size to either telescopic or reflected light methods of reading.

After the needle system had been properly assembled, and thoroughly dried, it was placed in the "astaticizer" or magnetizer. No description of this is necessary, as it is built entirely after the sug-

gestions of Mr. Wadsworth. The detailed drawing of the instrument used in this instance is shown in Fig. 6. Also Fig. 1 gives a fairly clear idea of its construction. In this case a current of five amperes was used, passing through the two coils in series each of 350 turns of No. 18 B. & S. (*i.e.*, 3,500 ampere turns). In Fig. 6 *B B* are screws by means of which the pole pieces may be loosened

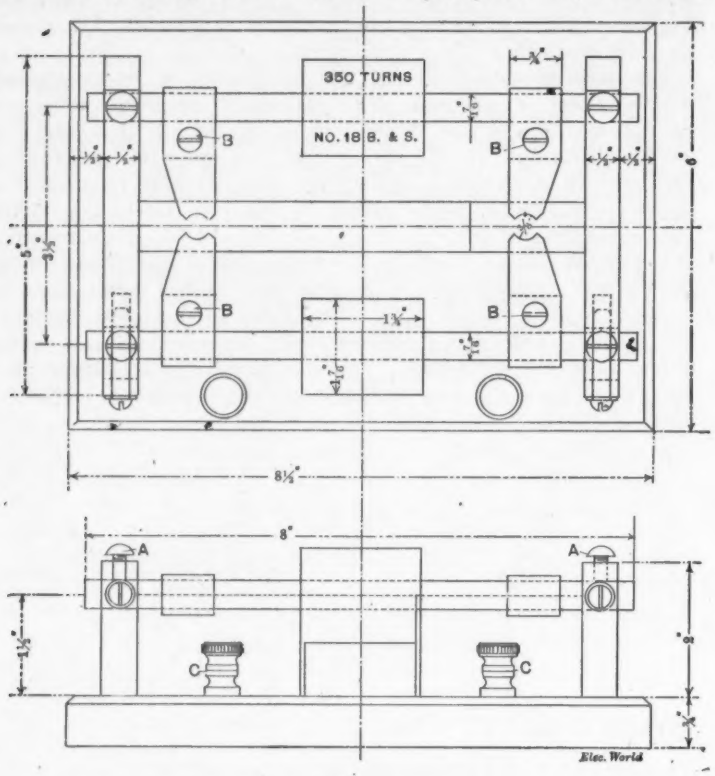


FIG. 6.

and their positions changed, suiting them for needles of quite various lengths. *A A* are set screws for holding the bars in place after adjustment by the front screws. The frame of the instrument was of cherry and the metal parts of the best Swedish iron.

GALVANOMETER DATA.

Instrument.	Resistance at 15° C.	No. of coils.	Needles. Kind.	Needles. Number. (Total.)	Needles. Wt. in mg of suspended parts.	Suspension.	Sensibility. ("Figure of merit." in Amperes.)
a—1...	5,891.7	4	Astatic	22	254	Quartz.	†19x10-11
a—2...	1,991.0	2	Bell.	1	.....	Silk.	5,370x10-11
a—3...	98.9	2	do.	1	.....	do.	30,180x10-11
b—1.	5,123.3	4	Astatic.	14	449	Silk.	62x10-11
*do. ..	do.	4	do.	68	578	do.	12x10-11
b—2...	4,983.0	4	do.	18	475	do.	39x10-11
b—3...	4.779.1	4	do.	14	492	do.	57x10-11
c—1...	4,014.4	4	Astatic.	14	486	Silk.	89x10-11
c—2...	4,068.0	4	do.	14	505	do.	107x10-11
d—1...	392.9	2	Astatic.	12	608	Silk.	398x10-11
d—2...	391.6	2	do.	12	422	do.	453x10-11
d—3...	394.8	2	do.	12	468	do.	560x10-11
d—4...	400.9	2	do.	12	490	do.	560x10-11
d—5...	390.7	2	do.	12	498	do.	594x10-11
d—6...	395 5	2	do.	12	506	do.	599x10-11
d—7...	384 4	2	do.	14	480	do.	685x10-11
d—8...	404.2	2	do.	12	522	do.	705x10-11
d—9 ..	398 3	2	do.	12	432	do.	748x10-11
e—1...	158.1	2	Astatic.	12	630	Silk.	1,055x10-11

* The same instrument, with new suspension; differing as shown.
† Manufacturer's statement.

Next in importance to the needle system are the coils. In this instrument each of the four coils were "graded" to secure the maximum electromagnetic effect, being wound after the following specification:

No. 40 B. & S.	590 ft.	= 590	ohms.
No. 36 "	904 "	= 374	"
No. 34 "	1,300 "	= 339	"
Total	1,301		"
Total resistance of instrument	5,204		ohms.

These coils were wound on specially made cast iron cores or spools, so arranged that one flange could be removed and the coil slipped off. Before winding, the spool was lined with paraffine paper. The No. 40 wire was used first and the No. 34 last. In fact, as before mentioned, these coils were wound after the method of Mr. Northrup, excepting that shellac was used instead of paraffine on the wire. The paraffine paper lining to the spool allows the coil to be readily removed upon gently heating it. Upon completion, the coils were mounted in the cups, and cemented in place with paraffine, leaving the winding exposed, and thus brought as nearly as possible to the needle system.

As to finish the instruments were thoroughly coated internally with shellac to increase insulation and also to keep the moisture from warping the frame. Externally they were finished off and polished with a hard oil finish, or with a varnish, after thorough smoothing down with pumice.

Such a set of instruments certainly cannot fail to be of interest, possessing as they do many original features in construction, combining many excellent principles already put forth by others, and illustrating what may be done with the recently propounded method of needle magnetization, even where those who undertake the work are not over highly skilled at it.

Grooved Rails for Electric Railways.

Some investigations, says the London *Engineer*, have recently been made to ascertain the most desirable shape for the groove to be used in the guard rails for curves on street railways, especially those operated electrically, the fundamental idea being that these grooves should be laid out corresponding to the lines of wear, so as to present from the start the largest possible wearing surface to the action of the wheels, in order to prolong the life of the rail. Two pair of wheels were carefully turned out of hard wood to an accurate scale of three inches to one foot, and with their axles—on which they were turned—secured to a strong frame representing the car truck, so that they could revolve freely but without any play. The frame was rigidly fastened in the centre to a stiff board extending at right angles with the truck, to what would be the centre of the curve. A pin accurately turned and fitting snugly in holes in the board, and holes in a wooden stand screwed to the floor, formed the centre proper. A large piece of drawing paper was stretched on a board, and on it were laid rail blanks without any groove, formed out of potters' clay, following the curves described by the wheels when allowed to move, guided by the board from the centre of the curve to whatever radius it was set. The wheels were then set upon the rail blanks and weighted until their flanges sank into the clay to their full depth, at which point the whole apparatus was arranged to be exactly level. The wheels having previously been varnished, were thoroughly oiled, so that the clay would not stick to them. The first pair of wheels was then revolved from the axle by hand, and thus the truck moved along the potters' clay, the flanges cutting their own grooves into it. The length of arc available having been traversed, the truck was lifted away, and if a perfect impression had been obtained short pieces were cut out of the various parts of the arcs of both the inner and outer rail, and particularly of those parts which had been traversed by the front wheels only or the hind wheels only, and those that had been passed over by both wheels, as comparison of them would show whether or not the truck stood exactly square with the radial line. These pieces were cut out so that the cut would also sever the paper underneath, and extending a short distance inside and outside, forming a strip on and by which the cut-out pieces could be slid away upon another board, and put away to dry and harden without handling the piece itself while yet soft, thereby avoiding possible distortion, except on the very ends, by the cutting knife. As this latter was unavoidable, the pieces, after being thoroughly hardened, were sawed in half, so as to get at the central undistorted section, and the sawed surface ground smooth on a piece of slate so as to present sharp lines. The shrinkage of the clay in drying could well be neglected, as actual measurement on a test piece showed that it would amount to little more than 1-64 inch in the full-size width of the groove.

Southwest London Polytechnic.

The new Southwest London Polytechnic, Manresa Road, Chelsea, is now rapidly approaching completion, and will, it is expected, be ready for opening at the commencement of the autumn.

Prevention of Electrolysis by Trolley Currents.

BY W. STUART-SMITH.

In an editorial comment in your issue of April 13, on my recent paper on the electrical condition of underground conductors within the influence of electric roads, it is stated that "The plan advocated by Mr. Smith to connect the rails to underground piping and employ the piping system as part of the underground circuit will not, we believe, meet with the approval of many, and we fear that the saving in copper entailed by such a method would have little weight in inducing gas and water companies to accord the necessary permission."

In this editorial you have credited me with advocating a plan which I have not for a moment thought of. You no doubt arrived at this conclusion from a somewhat hasty reading of my paper, and I am sure that a more careful reading of the latter part of the concluding section will show you that the plan I advocated was exactly the contrary of that with which you credit me.

In order to prevent electrolysis it is, of course, desirable that no current at all be allowed to enter the pipes, but this is impossible because as long as the rails are used for the return, some current will leak to the pipes wherever the track is +.

This current will all flow in the pipe systems, toward the power house, with a constantly increasing volume, and finally the potential relations between pipes and track will reverse, and the pipes becoming + to the track, the current will begin to leave them and electrolysis will begin to take place unless the return can be through metallic paths.

As soon as this condition obtains, my plan is to begin wiring pipes and track together, not for the purpose of making the pipes act as portion of the return circuit, but, on the contrary, to prevent such use in the greatest possible degree by taking the current, which is unavoidably present in the pipes, out of them at the *earliest possible* moment.

I prefer to begin wiring the track and pipes together at the farthest possible point from the power house where the pipes definitely become + to the track, and wire at every street crossing within the region where pipes are +; by so doing, the current which leaks to the pipes along the lower reaches of the road and spreads out so as to flow in the pipes for long distances on both sides will, on its return to the neighborhood of the track where the pipes are +, immediately find metallic paths by which it can return to the track, and thus prevent these numerous branch currents from finally accumulating as a current of large volume in one section, as would be the case if an attempt was made to rewire the pipes by heavy wiring near the power house only. My plan distributes the return from the pipes and thus minimizes danger of corrosion at resisting joints. Briefly, in order to prevent, as much as possible, the use of the pipes as a portion of the return conductor, the resistance between the track and pipes should be made as great as possible where the track is + to pipes, and small where the pipes are + to the track—in the first case to prevent the current getting into the pipes, and in the second to take out as soon as possible such current as does get in.

Now, with regard to the system of auxiliary conductors mentioned in the latter part of the editorial above indicated, whatever may be the value of such conductors when frequently connected with the rail and used as part of the regular return circuit, their value when specially led out and connected to pipes only is open to some question. By wiring track and pipes together as I have above stated, one or two No. 0 wires at the street crossings will be found adequate to so far remove the current from the pipes as to entirely neutralize the potential relation between pipes and track, and absolutely prevent any passage of current through the soil. By so doing the conductivity via the pipe systems as a whole will be somewhat increased, with the result of inducing slightly more leakage to pipes in those regions where the track is +; but this will also be the case if auxiliary conductors are used and only exemplifies the fact that good in one direction is apt to be accompanied by evil in another. In this case the good is of very large amount and the evil of little moment. If, however, auxiliary conductors connected to pipes only are used, it will be extremely difficult, and probably utterly impossible, to so proportion them as to prevent passage of current in one direction or the other between pipes and track. If the auxiliary conductor was so large and so frequently connected to the pipes that right up to the power house the track would be + to the pipes, there would certainly be no passage of current from pipes to track, and corrosion from that cause could not take place; but there would be leakage from track to pipes over the entire road instead of only a portion, as is the case when no wires are present, and as would be the case if my plan was followed. Also, the very greatly decreased potential of the pipe systems which would result from such large auxiliary conductors, would cause a greater potential difference between track and pipes along all portions of the road, thus inducing much greater leakage to pipes everywhere than would be the case with my plan.

Such auxiliary conductor, therefore, would have the effect of promoting exactly that use of the pipes as portions of the return conductor which the editorial condemns. If the auxiliary conductor was much smaller than that necessary to so far reduce the pipe potential that there would be no tendency for passage of current from pipe to track, the danger region would be contracted, but there would still be a portion where corrosion would take place, and the remedy would only be partial. The plan I propose is far simpler than the auxiliary conductor method; it takes but a few yards of wire to entirely rewire the potential difference between pipes and track throughout the region where pipes are +, it reduces to a minimum amount the use of pipes as return conductor—in fact it accomplishes the desired purpose. The auxiliary conductor requires a large amount of copper, which is expensive; it necessitates a large amount of digging in order to lay it; in order to be entirely effective in preventing passage of current from pipes to rail, it must be very large and greatly reduce the potential of the pipes, thereby increasing leakage to pipes and augmenting their use as portions of the return circuit; if smaller than this it still leaves a region where corrosion can take place. My plan is simple, cheap, and effective; the auxiliary conductor is expensive and does not achieve the desired end.

When the passage of current from pipes to track has been prevented, there still remain two sources of possible danger, the remedy for which is entirely outside the hands of the railway companies. These are the drop of potential over joints with consequent possible corrosion, and the potential difference between pipe systems which is the direct result of such drop over joints. The remedy is to have the ends of the pipes and the inside of the bells clean metal when making pipe joints. It is the general practice to have them coated with asphaltum.

The Spring Valley Water Company, of San Francisco, is now, on my advice, making all new joints with clean metal.

In wiring pipes and track it is, of course, necessary to wire both or all systems, otherwise the ones not so wired will be in a dangerous condition.

With regard to the auxiliary conductors, it would be much better for the railway companies if the copper they would require for this purpose were put in as supplementary to the rails, thus increasing the conductivity of the circuit and reducing the conductivity relatively to the pipe systems. The total leakage to pipes would thereby be reduced, and the total amount of corrosion correspondingly lessened.

To this extent such an augmenting of the rail return would be a benefit to the pipe companies, but there is a further consideration that furnishes another example of the companionship of good and evil. Increasing the conductivity of the rail circuit would cause a very considerable reduction of the rail potential, and if there was, from any cause, considerable leakage to pipes on the lower reaches of the road, it would result in the danger region, or region where pipes were + to track, being considerably expanded, and while thus the total corrosion would be less in amount, it would really represent a greater ultimate danger by being distributed over a larger territory. If my plan of neutralizing the danger was in all cases followed out, however, there would be a direct benefit to pipe systems in a good rail conductivity, because the volume of current in the pipes would be less and the danger caused by resisting joints be thereby reduced.

Electrical Fakes.

With reference to electrical fakirs in general, and one in particular, the *Worcester Spy* very sensibly says that when a man claims to get out of any mechanical device more than he puts into it, it is time to suspect either his sanity or his honesty. A correspondent of an electrical contemporary calls attention to a stock-selling speculation loudly advertised in a Boston daily paper, which has a very queer look about it. The promoters say that "the voltage distributor is a machine that multiplies electric horse power without materially increasing the cost of the original source of production." Any Worcester capitalist contemplating investing in any such scheme had better in the first place consult with a junior member of the electrical course at the Polytechnic Institute.

Electrodynamic Machinery.—XXXV.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

215. As has already been pointed out (Par. 12), all self-exciting continuous-current generators may be wound in one of three ways; namely,

(1.) Series-wound.
(2.) Shunt-wound.
(3.) Compound-wound.

216. Fig. 158 represents diagrammatically the connections between the field and armature of a series-wound generator. It will be observed that the current in the main circuit passes through the field magnet windings. The M. M. F. of the field coils increases directly with

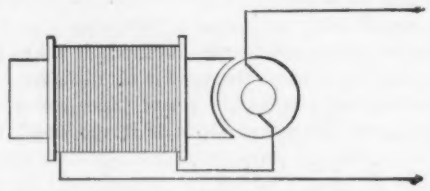


FIG. 158.—DIAGRAM OF SERIES WINDING.

the current strength through the circuit. So long as the iron in the magnetic circuit of the machine is far from being saturated, the flux through the armature increases with the M. M. F. approximately in direct proportion, and the E. M. F. of the armature, consequently, increases nearly in proportion to the current strength. As soon as the iron in the circuit approaches saturation, the flux increases more slowly, and finally, the E. M. F. of the armature is scarcely increased by any increase in the current strength through the circuit.

217. Fig. 159 represents diagrammatically the connections between the field and armature of a shunt-wound generator. Here the field magnets are wound with fine wire and the windings are connected in parallel with the external circuit, instead of being connected in series with it. Consequently, if the pressure at the brushes be considered as uniform, the current strength passing through the magnet coils must, by Ohm's law, be uniform independent of the current strength in the main circuit. Thus, if the pressure at the brushes be assumed constant, at, say 100 volts, and the resistance of the magnet coils be 50 ohms, then the current strength through the magnet coils will be two amperes independently of the strength of current supplied to the main circuit.

218 Practically, however, owing to the drop of pressure in the armature as the load increases, and also on account of the shifting of the brushes that may be necessary with the increase of load, the pressure at the brushes diminishes, and the current strength through the field magnets diminishes in the same proportion. The tendency in a shunt-wound machine is, therefore, to diminish its M. M. F., and its resulting E. M. F., as the load on the generator increases. In order to maintain a constant pressure at the brushes under all

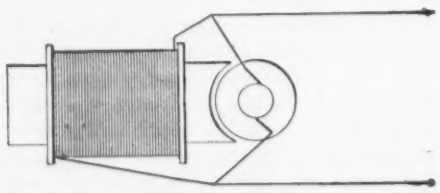


FIG. 159.—DIAGRAM OF SHUNT WINDING.

variations of load, it is necessary to adjust the strength of current passing through the field magnets, so that the M. M. F. at full load shall be slightly in excess of the M. M. F. at light load. This is usually accomplished by the insertion of a rheostat in the field magnet circuit, so that some or all of this resistance can be cut out by hand at full load, thereby increasing the current strength through the magnet coils.

219 If, for example, the full load activity of the machine be 10 kw at 100 volts pressure, the full load current strength will be 100 amperes. Assuming the resistance of the armature to be 0.05 ohm, the drop of pressure in the armature at full load will be 100 x 0.05 = 5 volts, and the additional drop of pressure, owing to the shifting of the brushes in order to avoid sparking, may be two volts more, making a total drop in pressure of seven volts. The effect of this drop would be to reduce the current strength in the field magnet coils from two amperes to $\frac{93}{50} = 1.86$ amperes, thus reducing the flux through the armature and the E. M. F., so that a balance between the E. M. F. and M. M. F. might be found at, say, 90 volts, if no means were adopted to regulate the current strength through the field coils. In other words, the pressure at the brushes would vary by 10 volts between light and full load.

220. Fig. 160 represents the connections between the field and armature of a compound-wound generator. Here the principal M. M. F. furnished by the magnet coils is that due to the shunt coil, composed of many turns of fine wire, an auxiliary series coil, of comparatively few turns of coarse wire, being also employed in the main circuit. As the load increases, the M. M. F. generated by the shunt winding tends to diminish as above described, but the M. M. F. due to the series coil increases. By suitably proportioning these two opposite influences, the M. M. F. may be automatically so controlled that the pressure at the brushes shall remain constant, either at the brushes of the generator, or at the terminals of the motor or other translating device, which may be situated at a considerable distance from the generator. In order to effect this latter result, the M. M. F. of the series coil must compensate not only for the drop in the armature, but also for the drop in the conductors leading from the generator to the motor, so that these external conductors may be regarded electrically as forming an extension of the armature winding, and, in this sense, the generator delivers a constant pressure at its final terminals on the motor. Such a machine is said to be *overcompounded*.

221. Series-wound generators are almost invariably employed for series arc lighting, since it would be very difficult to supply the required M. M. F. for their magnets by a shunt winding, considering that the pressure at the brushes varies between such wide limits,

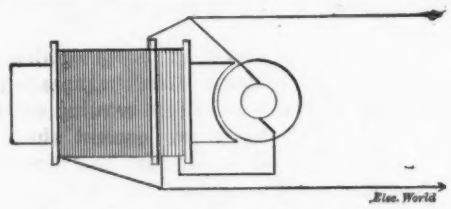


FIG. 160.—DIAGRAM OF COMPOUND WINDING.

and even if such shunt winding could be supplied it would necessarily be formed of a very long and of fine wire, and consequently would become troublesome and expensive. Series arc lighting generators are sometimes constructed for as many as 200 lights, representing about 10,000 volts at the generator terminals at full load, and a shunt winding for such a pressure would be very expensive.

222. Shunt-wound generators are usually employed for supplying incandescent lighting from central station, and their pressure is varied by hand regulation.

Compound-wound generators are usually employed for supplying motors from central stations, and also for incandescent lights and motors in isolated plants.

223. In the design and use of generators it is important to know how the E. M. F. generated in the armature at a given speed varies with the current passing through the field magnets. We have seen that the E. M. F. in the armature, in C. G. S. units, so long as the brushes remained unaltered in position, is equal to the product of the number of turns on the armature, the number of useful webers passing through the armature from each pole, half the number of poles, and the number of revolutions per second. Consequently, the E. M. F. of such an armature, running at a constant speed, depends directly upon the flux through its magnetic circuit or circuits. If we vary the current strength through the field magnets, and, consequently, the M. M. F., we can observe the pressure in volts, which the machine will deliver at its brushes at light load. A series of such observations, plotted in a curve, gives what is called the *characteristic curve* of the generator. In the case of a self-exciting, series-wound generator, it is only possible to vary the M. M. F. by varying the load, and, consequently, by including in the pressure at the brushes the drop taking place in the armature. The curve obtained from a series-wound machine under such circumstances, is called an *external characteristic*, and the *internal characteristic* may be determined from it by correcting for the drop in the armature.

224. Fig. 161 represents the internal and external characteristics of a particular series-wound generator intended to supply a maximum of 70 amperes at 50 volts terminal pressure or 3,500 watts.

The pressure at terminals, when the load was varied so as to produce the required variations of current strength through the magnets, followed the broken line *A B C*, which is, therefore, the external characteristic of the machine. If we add to the ordinates of this line from point to point, the drop of pressure in the armature at the corresponding current strength, the full line 0 *D E F*,

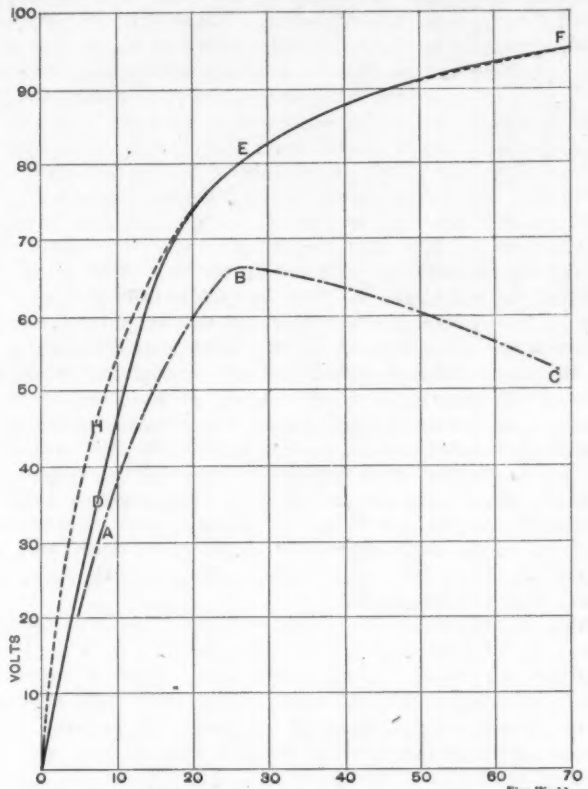


FIG. 161.—CURVE OF E. M. F. DEVELOPED IN THE ARMATURE OF A SERIES-WOUND DYNAMO, WITH REFERENCE TO CURRENT STRENGTH IN A CIRCUIT.

is obtained, which is, therefore, the internal characteristic of the generator or the curve of its E. M. F. in relation to the exciting current in its field coils.

The useful E. M. F. developed by the armature may be expressed by the formula,

$$E = \frac{I}{x + y I}$$

so that, if two observations are secured, the whole curve may be deduced to a very fair degree of accuracy. For example, in Fig. 161, the E. M. F. at 20 amperes = 74 volts, and at 70 amperes, 95 volts. From these observations we may take the two equations,

$$74 = \frac{20}{x + 20y} \text{ and } 95 = \frac{70}{x + 70y}.$$

From these two equations we obtain $x = 0.0836$ and $y = 0.00933$, so that the E. M. F. at any current strength through the field magnets is

$$E = \frac{I}{0.0836 + 0.00933 I}.$$

The dotted curve 0 *H E F*, which is lying close to the full curve 0 *D E F*, represents the locus of this equation. It will be observed that the dotted line practically coincides with the full line representing the observations, except within the first 20 amperes of magnetizing current strength.

225. Fig. 162 represents the characteristic curve of a shunt-wound generator, of 200-kw capacity. Here the current strength through the field magnets was not observed, but the pressure acting on the field coils was noted. Assuming, as would probably be very nearly true, that the resistance of the field magnet coils would be constant throughout the observations, the exciting current strength would be proportional to the pressure acting on the coils; with 40 volts on the magnets, the E. M. F. at the brushes with the external circuit broken was 71 volts, and increased, as shown by the full line *A B C*, to 185 volts, with 140 volts on the magnets. Here also the E. M. F., *E*, may be expressed by the Frölich equation, $E = \frac{e}{x + ye}$, the e being the pressure on the field magnets; taking the two observations, $120 = \frac{70}{x + 70y}$ and $174 = \frac{120}{x + 120y}$ we find $x = 0.43$ and $y = 0.0022$, from which the general equation becomes,

$$E = \frac{e}{0.43 + 0.0022 e} \text{ volts.}$$

The locus of this equation is represented by the dotted line, which practically coincides with the full line *A B C* of observation.

226. When, therefore, two reliable observations have been made of the E. M. F. generated by an armature, at observed exciting current strengths or pressures situated not too closely together, it is possible to construct the characteristic curve throughout to a degree of accuracy sufficient for all practical purposes.

The Frölich equation, by which this is possible, is a consequence of the fact that the reluctance of the air paths in the magnetic circuit of a generator is constant, while the reluctivity of the iron in the circuit is everywhere capable of being expressed by the formula $= a + b\,\mathfrak{IC}$ (Par. 51) and, consequently, the total apparent reluctance of the armature takes the form $x + y\,\mathfrak{M}$, and the useful flux passing through the armature $\phi = \frac{\mathfrak{M}}{x + y\,\mathfrak{M}}$, $\mathfrak{M}$, being the magnetomotive force in gilberts in ampere-turns, in amperes or in volts supplied to the coils.

227. When the characteristic curves of a shunt machine have been obtained, it is a simple matter to determine what the series winding must be in order to properly compound it, for either the drop in the armature or the drop in any given external circuit as well. Thus, suppose that it be required to determine the series winding for the machine whose characteristic curve is represented in Fig. 162. If the E. M. F. required at the terminals of the machine be 120 volts at all loads, and if the drop in the armature due to its resistance at full load, as well as the resistance of its series coil and also due to any shifting of the brushes that may be necessary, amounts in all to 10 volts, then the full load current must supply the M. M. F. necessary to carry the E. M. F. from 120 to 130 volts, equivalent to raising the pressure by eight volts from 70 to

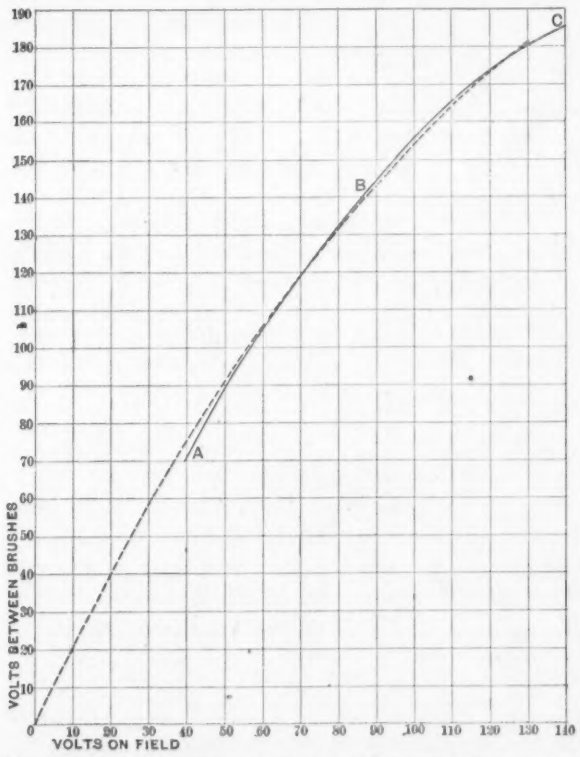


FIG. 162.—CHARACTERISTIC CURVE OF SHUNT-WOUND DYNAMO.

78 volts on the shunt winding. The increase in current strength from the shunt winding represented by these eight volts multiplied by the number of turns in the shunt winding, gives the M. M. F. required, and the full load current must pass through a sufficient number of turns to supply this M. M. F. in its series coil.

(To be continued.)

Electric Traction in Brazil.

The *Jornal do Brazil* states that work has been commenced on the Santa Theresa Electric Railway at Laderia de Santo Antonio.

Rope Driving—XV.

BY J. J. FLATHER.

For a head or jack shaft carrying heavier pulleys, the weight acting on the bearings may be taken equal to four times the bare weight of shaft, in which case, other conditions remaining the same, we obtain

$$F = \frac{4}{\pi}\phi\sqrt{\left[\frac{4\pi}{4}\left(3.36\,d^3\right)L + \sin 30^\circ \times \frac{1}{4}\left(\frac{3}{2}d^3N\right)\right]^2 + \left[1\quad\left(\frac{3}{2}d^3N\right)\right]^2}$$

Since, however, the extra weight of pulleys on a jack shaft is liable to produce a greater bending moment, it is customary to assume a larger shaft to transmit a given horse power; therefore, instead of using $\frac{d^3N}{100}$ as the working horse power transmissible by the shaft, it is better to use under these conditions HP $= \frac{d^3N}{125}$

From this value of the power transmitted we obtain

$$F = \frac{4}{\pi}\phi\sqrt{\left[\frac{4\pi}{4}\left(3.36\,d^3\right)L + \sin 30^\circ \times \frac{1}{4}\left(\frac{3}{2}\times .8\,d^3N\right)\right]^2 + \left[1.2\left(\frac{3}{2}\times .8\,d^3N\right)\right]^2}$$

$$= \sqrt{[0.8\,d^3L + 0.0114\,d^3N]^2 + [0.11\,d^3N]^2}$$

The ratio of power absorbed by friction to the horse power which the shaft is capable of safely transmitting will now become

$$\frac{HP_0}{HP} = \frac{0.0^3 8\,d\,NF}{0.008\,d^3N} = \frac{0.10\,F}{d^2}\text{ per cent.,}$$

from which Table XIV. has been determined. In calculating the values given in this table it has been assumed that the belt speeds are the same as those previously considered, namely, 2,640 feet per minute for main belts to head shaft, and one-fourth of this, or 660 feet per minute, from head shaft to auxiliary shafting; this may be low in many cases, but, as already pointed out, the force, F, will decrease under the assumed conditions as the belt speed increases, so that for higher speeds we may expect the friction loss obtained by the above formula to be somewhat less than the actual.

TABLE XIV.—POWER ABSORBED BY FRICTION IN JACK OR HEAD SHAFTS.

Diameter of Shaft in Inches.	Revolutions per Minute.	Percentage of Loss when Length in Feet =	
		50	100
2	100	4.8	8.5
	250	7.2	10.1
	400	10.0	12.5
2½	100	5.1	8.7
	250	8.3	11.0
	400	12.2	14.3
3	100	5.5	9
	250	9.5	12
	400	14.2	16.1
3½	100	5.8	9.1
	250	11.5	12.9
	400	16.6	17.8
4	100	6.3	9.5
	250	12.1	14.2
	400	18.4	20.5

In the foregoing discussion it has been assumed that the shaft transmits its allowable maximum power, that is, for line shafting the power transmitted $= \frac{d^3N}{100}$, and for head shafts the power transmitted $= \frac{d^3N}{125}$.

As a general thing the actual average power transmitted by a shaft is seldom more than about three-fourths of its assumed working capacity, and since the weight and speed remain practically constant, the percentage of loss under conditions approximating those we have assumed will be somewhat greater than that given in the table. But while the power transmitted is diminished 25 per cent., the percentage of increase in friction loss will vary between wide limits, depending upon the speed of rotation and length of shaft; thus for a 3″ head shaft 100 feet long, delivering three-fourths of its allowable capacity at 100 revolutions per minute, the loss increases from 9.0 to 11.5 per cent., which represents an increase of 28 per cent.; at 250 revolutions the loss is now 14.0 per cent., corresponding to an increase of 14.3 per cent., while at 400 revolutions the loss is 17.8 per cent.—a gain of only 10.6 per cent.

For these determinations it is supposed that the shafting is properly supported, with hangers sufficiently close to each other to prevent undue deflection under working conditions, and that the shaft is in line, having good bearings and well lubricated. Departures from these assumptions will further increase the friction loss, but, on the other hand, this loss will be decreased if lighter or fewer pulleys are used throughout the length of the shaft, or if the machines be belted directly from the shaft below. Where shafting is employed, there will generally be an additional loss due to the friction of the auxiliary shafting and countershafts, which is extremely variable.

It is outside the province of the present article to discuss the losses in these secondary shafts; the losses which we have been here considering are those which exist in main line shafting, jack and head shafts receiving their power presumably by leather belting or ropes, with either of which, for similar drives, there should be no appreciable difference in the total weights of pulleys and shafting and the friction involved. The diameter of grooved shaft pulleys will be larger and the rim will be thicker, but for the same horse power transmitted the width will be less and the weight not materially increased. In any case, the total weight of grooved pulleys, compared with that of belt pulleys used in the same system is usually very small, and any individual differences may be neglected when taken as a whole. In those cases where ropes are used exclusively, as, for instance, in dynamo rooms and other power stations, the pulleys are frequently heavier and the shafting is generally fitted with a number of friction clutches, thus materially increasing the weight on the bearings; in cotton mills, also, where the ropes are geared direct from the engine to the various floors of the mill, there is frequently a heavy stress on the shaft, especially on the upper floors, due to the weight of the ropes; under such conditions the receiving shafts should be considered as head shafts.

In work of this nature the velocity of the ropes is usually much greater, both from the engine to the first shaft and from the latter to the machine or secondary shaft. Assuming a speed of rope double that used for the previous tables and letting the weight of pulleys, ropes, clutches and couplings equal four times the weight of shaft, it can be shown that the formula for the friction load will be reduced to

$$F = \sqrt{[0.8\,d^2L \times 0.0057\,d^3N]^2 + (0.033\,d^3N)^2}$$

From this formula Table XV. has been calculated, and may be considered to represent the percentage of loss in the first shaft when working under full load; with lighter loads the percentage will be greater.

TABLE XV.—POWER ABSORBED BY HEAD SHAFTS CARRYING HIGH SPEED ROPES.

Diameter of Shaft in Inches.	Revolutions per Minute.	Percentage of Loss when Length of Shaft in Feet =	
		50	100
2½	100	4.2	8.1
	250	4.8	8.6
	400	5.6	9.2
3	100	4.3	8.2
	250	5.2	8.7
	400	6.0	9.5
3½	100	4.3	8.3
	250	5.3	8.8
	400	6.2	9.6
4	100	4.4	8.3
	250	5.6	9.1
	400	7.1	10.1

Line of action of resultant of tensions in main drive = 30°.
Velocity of ropes from engine, 5,280 feet per minute.
Ropes from shaft are horizontal and run at an average of 2,640 feet per minute.
All ropes drive from one side of the shaft toward the engine.
Weight on bearings four times weight of bare shaft.

It must be noted that with any other arrangement of shafts the friction loss will vary; in the present case the ropes from the engine to the jack shaft make an angle of 25° with the horizontal, and the ropes from the jack shaft back to the machine or secondary shaft are horizontal, as in Fig. 41.

When rope wells are used, each successively higher shaft will have an increased friction percentage, since the belt pull becomes more nearly vertical and the resultant load on each shaft is thereby increased.

It is worthy of remark that in long lines of shafting with high rim velocity the influence of belt pull on the bearings is very slight compared to the weight of shaft and pulleys, so that the loss in friction is but little more than that due to weight alone. We see in

this an additional argument for high rotative speeds in shafting, for while the percentage of loss increases, say from 8.1 to 9.2 in a 3-inch shaft running at 100 and 400 revolutions per minute, respectively, the power transmitted by the shaft, as calculated from $HP = \frac{d^3 N}{125}$ increases from 21½ for 100 revolutions per minute to about 87 *HP* for 400 revolutions per minute, so that while the friction percentage increases in the ratio $\frac{9.2}{8.1} = 1.14$ to 1, the power transmitted increases in the ratio of the number of revolutions per minute, or 4 to 1. With higher belt velocities and increased rotative speeds in

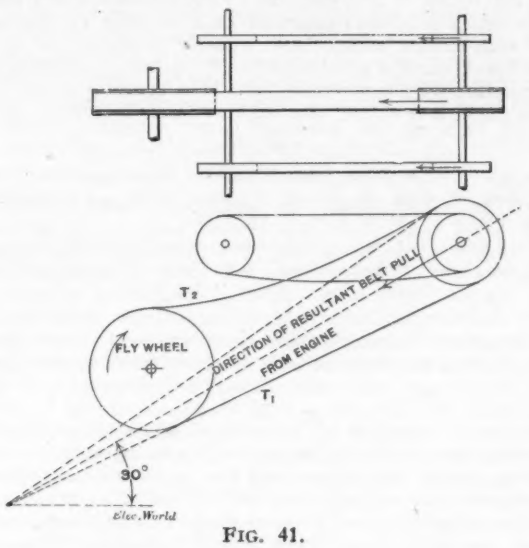


FIG. 41.

our factory shafting, the friction loss, instead of being from 30 to 50 per cent. of the total power transmitted, ought not to exceed one-half of these percentages. For with higher speeds narrower and lighter pulleys could be used, the belts could be run slacker, and lighter shafting could be employed.

Although it has been previously considered in a general way that the friction due to the shafting may be taken as about 10 per cent. of the full power transmitted to the shaft, yet in the light of further investigation it will be seen that, owing to the various conditions under which the shafting is run, no general value for friction loss can be assigned.

While the friction absorbed by large engines is reasonably less for rope-geared fly-wheels when compared with engines using flat belts, driving in a similar manner, there seems to be no good reason for supposing that the friction in ordinary mill shafting should be appreciably different when rope-driven.

On account of the larger diameter of pulleys used with rope driving, the velocity of the rope may be, and usually is, greater than that in a belt used in the same place, and for this reason the pull on the shaft due to the tensions in the rope may be less; but with long lines of rope-driven mill shafting the main drives only are of rope, and any difference in pull on the bearings which might exist in favor of the rope-driven main shaft must necessarily be small when compared with the total friction load due to the pull of the numerous cross or machine belts which, running at a greatly reduced speed, produce by far the greater effect on the shaft. With short lines of shafting, however, there will generally be a small saving in favor of a rope-driven plant. Under these conditions the effect of the ropes to and from the first motion shaft is usually in excess of that due to the belts which may be used to transmit power from the main or jack shaft to secondary shafts or machines, and, therefore, since the rope pull is less than would be produced by belts used in the same place, we may expect the friction to be less. When ropes are used entirely, as in electric and other power stations, we should expect the friction loss to be somewhat less, assuming that the ropes are run at a higher speed than would be used for belts in the same place.

(To be continued.)

An Electrical Cat.

To the Editor of The Electrical World:

SIR: I am the possessor of a pet cat, and to-day after having held her in my arms, I went to put her down, and instead of dropping her outright, I let her fore-paws slip off my left arm, still holding her with a grip of my right hand at her flanks just above or in front of her hips. This brought her into a position, with head down and paws extended, and as I relaxed my grip, preparing to drop her, my middle finger pressed on some muscle or organ, which gave me a slight shock, quite similar to that received from a person charged by friction of the feet on a carpet.

I was naturally surprised, and repeated the operation six times with the same result each time.

This afternoon I related my experiment to a professor at the Buffalo Electrical Engineering School, who advised me to write you and have you disseminate the facts, that some of the readers of your valuable journal might experiment and investigate further.

I am of the opinion that the cat may possess, on a small scale, an organ of the nature of the Electric Torpedo and Gymnotus mentioned in text-books. F. H. BALCOM.

BUFFALO, N. Y.

The Power Factor of a Synchronous Motor.

To the Editor of The Electrical World:

SIR:—In a recent article* entitled "The Action of a Single-Phase Synchronous Motor," giving the results of an extended series of experiments conducted by Prof. Ryan and myself, reference was made to the work of other investigators in this direction, beginning with the first operation of the synchronous motor by Wilde in 1868, and the first discussion of its theory by Hopkinson in 1884.

In the experimental treatment of the synchronous motor, as given by us, analytical discussion was excluded. Our investigation showed the condition of operation under which it is possible to obtain the minimum current and maximum power factor, a relation obtained by Mr. Mordey and called attention to by him in 1893. It is of interest to note that this relation was theoretically deduced by Prof. Blondel the year before and given by him in "La Lumière Electrique," Vol. 45, p. 423, in his extensive memoir on the synchronizing of alternators. No bibliography on the theory of the synchronous motor would be complete without reference to this article, and I must thank Prof. Blondel for calling my attention to the bearing it has upon the relation shown by Mr. Mordey. I take pleasure in calling the attention of your readers to the elaborate theoretical treatment by Prof. Blondel, for from it many conclusions concerning the action of a synchronous motor may be readily deduced, and it should take an important place in the literature of the subject. Yours very truly, FREDERICK BEDELL.

ITHACA, N. Y.

Maxwell and Joubert.

To the Editor of The Electrical World:

SIR:—I read with much interest Mons. Andre Blondel's biographical sketch of Prof. Jules Francois Joubert in the last issue of your esteemed journal. This sketch contains a statement which I cannot pass without a comment. It is this: "*It is to Professor Joubert that the honor belongs of having found the law of simple alternating currents, represented by the two well-known formulas*

$$I = \frac{E_0}{\sqrt{R^2 + \left(\frac{2\pi L}{T}\right)^2}} \sin 2\pi \left(\frac{t}{T} - \phi\right)$$

$$\text{and } \tan \phi = \frac{2\pi}{T} \frac{L}{R}$$

which define the apparent resistance effect, called impedance to-day, and the lag in phase. It would only be just to give definitely to these formulas the name of Joubert's law."

In his great essay on "A Dynamical Theory of the Electromagnetic Field," published in 1864, Maxwell not only gave these formulæ, but he also showed how the self induction and the resistance, and therefore the impedance of a primary circuit is modified by the presence of a closed secondary. In fact, the whole theory of the ideal modern transformer and alternator was given in this essay. (See pages 546 and 547, vol I, of Maxwell's scientific papers.) I do not see how this can be reconciled with Mons. Blondel's statement that "*Maxwell had approached the question in two or three notes, but without results,* . . . . . ." Professor Joubert's reputation rests on big things and needs no bolstering up by these little trifles, which are as light as air. M. I. PUPIN.

NEW YORK, N. Y.

*Reprinted in a slightly condensed form in THE ELECTRICAL WORLD of April 6.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Force Experienced by Iron-embedded Armature Conductors.—The Lond. "Elec.," April 19, contains a short paper by Mr. Sayers in which he shows that in iron-embedded conductors the driving force is borne directly by the iron instead of by the conductors, as in the case of smooth core machines. Taking the case of an armature in which the thickness of each projection is equal to the space between them, he shows that, when the induction in the iron is 16,000 and the field in which the conductors are immersed is 50 while in a smooth core armature it would be 8,025—then the force on the embedded conductor is 165 times greater in the latter than in the former. The lines of force in the case of the embedded conductor must travel across the solid at a very much greater rate than the peripheral velocity of the armature, in this case about 164 times as great, and traveling in a direction opposite to that of the rotation of the armature; a curious point is, that the arrangement constitutes a kind of speed gear whereby the relative velocities of the conductors and fields in which they are immersed is enormously greater than the actual velocity of the periphery of the armature and that the forces experienced by the iron must be due to the reaction of the lines of force which are being propelled at a high rate of speed in the opposite direction to the conductors. In another example he takes a larger magnetic induction in which he finds that the force is only 16 times as great; if the induction be taken less the force on the conductors will be a still smaller fraction of the total.

Armature Reaction.—The leading editorial in the Lond. "Elec.," April 19, on "Recent Papers on Dynamo Design" compares the recent American paper by Prof. Ryan and Mr. Thompson with the recent English paper of Mr. Sayers; the problem which these two devices are intended to solve is claimed to be precisely the same in both but the solutions are different; in principle that of Ryan and Thompson does not appear nearly as radical a remedy so far as armature reaction is concerned; the editorial claims that sparking at the brushes is a thing of the past and that it is now not worth while striving to attain greater fixity of position of the brushes at the cost of any complication; inventors it is stated are apt to recommend panaceas for evils which do not practically exist; it may still be asked, however, at what cost this perfection is secured (referring to the usual forms of dynamos and not to these devices); a long air gap is a necessity which signifies a large expenditure of copper and a long magnetic circuit; the real aim of the devices described in these papers is to show how it may be possible to use armatures with projections and with short air gaps thereby lessening the copper and iron required; it does not think that the claim that the output of the armature may be greatly increased, is well founded as it believes that in the ordinary armatures the limits fixed by heating and sparking are reached at nearly the same output. If both devices are equally efficient it gives preference to that of Sayers.

Deductions from Dynamo Characteristics. — In a short article in "L'Eclairage Elec.," March 30, it is shown how certain deductions may be made from the characteristics. Assume that the curves are given, whose ordinates are the volts at the terminals and the abscissas are the exciting currents, the machine being separately excited; a separate curve is given for each of several constant currents in the armature; if a line be drawn through the origin making an angle with the horizontal axis whose tangent is equal to the resistance of the shunt magnets then the ordinates for the points of intersection of this line with these curves represents the difference of potential which must be applied to the magnet terminals in order to give the excitation corresponding to those abscissas; the points of intersection are those for which there will be an equilibrium between the difference of potential at the terminals of the armature and that applied to the magnets to obtain the required excitation; (the explanation is not as clear as might be desired). He also gives a formula, which is not very simple, for calculating what the speed must be to obtain a somewhat different voltage at a certain fixed current.

Non-synchronous Polyphase Motors.—The "Bull. l'Ass'n Ing. El. Montefiore," vol. 6, No. 1, 2, 3, contains a long presidential address by Mr. de Bast in which he gives a summary of a number of papers on the theory of such motors, which have recently appeared in Europe and discusses them from the standpoint of the engineer, giving in as simple form as possible the characteristic equations concerning the action of these machines; it is chiefly of a mathematical character.

LIGHTS AND LIGHTING.

Silvered Bulbs.—The table from which the abstract in the Digest, Jan. 20, was taken, showing the saving of power in the use of silvered bulbs, is reprinted in the "Elek. Anz.," April 14.

Holophane Globes.—A brief illustrated description of the principles involved in these globes (which have been fully described in these columns) is given in the Lond. "Elec.," April 19.

Price of Incandescent Lamps.—According to the "Elek. Anz.," April 18, the agreement among German manufacturers to sell lamps at a uniform price has not been adhered to; one firm sells lamps at 13¾ cts. each.

Illumination of Streets and Public Places.—The "Eng. Mag." for May contains an article by Mr. F. Pope in which he discusses briefly oil and gas lighting, giving costs of each and then more in detail, electric lighting; he describes briefly the tower system used in Elgin, Ill., and gives as his opinion that the most satisfactory plant for arc lamps under ordinary conditions is to suspend them from a mast-arm placed at the corners of streets. From the analysis of a large volume of trustworthy statistics he concludes that for a plant of about 100 arcs operated by steam power and doing no commercial lighting, the actual cost per lamp cannot at present prices be brought below $100 per year for all-night lighting of 4,000 hours or $65 for 2,200 hours; figures frequently appearing in the newspapers giving materially lower prices in order to induce municipalities to construct their own plants are therefore wholly untrustworthy. In conclusion he describes the series incandescent system which he thinks will ultimately be adopted in general for public lighting in all except possibly the largest cities and towns; such lamps should not be less than 20 or more than 32 cp to combine economy and good distribution; they should be located at intervals of 250 to 300 feet which may be reduced to 125 feet in the central districts and increased in the suburbs; a fair contract price for supplying and operating 25-cp lamps for street lighting would be $20 to $24 per year when burned until midnight; with cheap water power they have been supplied for $16; a 25-cp lamp will in practice give two or three times as much effective light as the average gas lamp. The choice of the system for public lighting depends upon the particular conditions, in the majority of cases a series incandescent system will be the best, but for brilliant lighting the arc light is better; nevertheless the kerosene lamp in skillful hands will give results which suffer but little in comparison.

POWER AND HEAT.

Transmission Plant at Goule.—A brief description of this plant in Switzerland is given in "L'Ind. Elec.," April 10. The power from a waterfall is transmitted electrically for lighting and power purposes, to a number of different cities and towns; it is said to be of special interest on account of the great extent of the area over which it is distributed. The simple alternating current is used; there are three turbines of 500-hp each which are directly connected with three alternators, generating currents of 5,500 volts and 63 amperes at a frequency of 50; separate systems of leads are used for the motors and for the lights, the motors being run at 240 volts and the lamps at about half that on a three-wire system; the motors used are non-synchronous, single phase, alternating current motors made by the Oerlikon Company; the starting apparatus is said to be very simple (but is not described) and it is said that they have given perfect satisfaction and that this installation has demonstrated that the problem of the alternating current motor has been solved; at present there are connected about 10 motors varying from 1 to 15-hp.

Thermopile.—In an illustrated article by Mr. Cox in the "Elec. Eng.," May 1, he describes at some length the principles of his "thermoelectric generator" (a true thermopile), and gives illustrations of the apparatus. He claims that the fatal defect of thermopiles as formerly used was the lack of stability; they deteriorated rapidly; his apparatus is intended to overcome this defect. The oxidation at the junction which was said to be a serious defect in the other forms, is claimed to be overcome by having no real junction point, which is here formed of a "graduated alloy; that is the two alloys composing the element are graduated or shaded one into the other so that there is no real point of junction;"

the fusion point of the alloy is over 1,000 degrees less than that of the cross connection or solid alloy; further than this he does not describe the alloy or its constituent parts. The complete element is encased in cement which is afterward vitrified thus preserving it from oxidation, the whole pile forming a hard, stone cylinder; the elements are arranged as usual in thermopiles, forming a hollow cylinder; around the outside is a water jacket; the apparatus is said to have been in use for three years without showing signs of deterioration. The average gas consumption is 2.5 cubic feet per hour for an output in the external circuit of 45 watts; with seven feet per hour the Commercial Cable Company operated its entire lines for several weeks with these generators, from the New York office, representing a saving at that station of eight to one in favor of the generator over its present system; their entire system will be equipped with these; a 55-volt five-ampere coal burning generator is shown which with coal at $4.50 per ton generates current at 0.2 cent. per lamp hour (the candle-power is not given). He adds that he has discovered that it required a "particular form or kind of heat" there being a great difference in the output with various forms and kinds of fuel, the output being increased 300 per cent. by "simply using the proper heat."

TRACTION.

Accumulator Traction.—According to a recent paper by Mr. Sarcia read before the International Society of Electricians in Paris the following improvements are to be made in the accumulator system used in Paris: the charge was formerly at a constant potential but the very large charging current at the start injured the plates; the voltage formerly was 255 for 108 cells, it will now be made 220 during the first period of about an hour and a half and 255 during the remainder, the total charge lasting four hours. The batteries were formerly placed under the seats which resulted in frequent accidents owing to the upsetting of the sulphuric acid and the change of the cells involved considerable time; the batteries will now be placed between the two separate trucks, being put in place by hydraulic process in the pit below the car. The weight of the car and the batteries is 12 tons the accumulators weighing 2.5 tons; the positive plates will contain a core of antimonous (10 per cent.) lead; the coal consumption for the last year was 9.2 pounds per car mile.

Accumulator Traction in Vienna.—The "Elek. Echo" for April concludes its lengthy description of this proposed installation, including illustrations of the car and detailed estimates of the cost.

Jungfrau Railway.—The "Elek. Anz.," April 18, gives a few details regarding the water power station for this unique mountain railway, the plans of which station have been completed. There will be two power stations on the White Luetschine, an upper and a lower one both for high pressure falls; the total power will be 4,400 hp; at one station there will be four dynamos of 470 hp each, coupled directly with turbines with horizontal axes; a 35 hp turbine is used for the exciters (from which fact it appears that alternating currents may be used but there is no statement to this effect); in the other station there will be four direct coupled dynamos of 1,000-hp each.

Mountain Climbing Railways.—In the continuation of Mr. Scott's article in the Lond. "Elec. Eng.," April 19, he gives a brief description of nine different roads in Switzerland some of which use electricity as the motive power.

Surface Conductor System.—According to a note in the Lond. "Elec.," April 19, the Claret-Wuillemier system (which has been used in Lyons and which was described in the Digest, Oct. 15 and 22), is to be used in a line from Paris to a suburb for a distance of a little over four miles of double track road.

Budapest Conduit Road.—The "Rev. Industrielle" abstracts a description from the "Ann. des Ponts et Chaussees;" illustrations are given of the motor, truck, conduit and collecting shoe; (the latter illustrations are not usually given in the description of this road, but it is unfortunately not very clear.)

High Speed Traction.—According to the "Elek. Anz.," April 18, the Western Railway Company of France has ordered two electric locomotives from the Heilmann syndicate which are to be delivered in June; the locomotives each weigh 110 tons and can draw a load of 200 tons at a speed of 62 miles per hour.

Electric Railways in Italy.—According to an official report which is abstracted in the "Zeit. fuer Elek.," April 15, there were on Jan. 1, in Italy four electric roads having a total length of about 7.5 miles.

Will the Electric Motor Supersede the Steam Locomotive?—An article with this title by Mr. Wetzler is published in "Scribner's Mag." for May. He discusses the growth of electric railways stating that at present there are over 850 electric railways in the United States having 9,000 miles of track, 23,000 cars, and representing an investment of over $4,000,000, while in 1887 there were only 13 roads with scarcely 100 cars; he believes there are no less than 500 miles of electric road running parallel to steam roads and 1,000 miles running or in the course of construction; he shows how they gradually developed by a process of linking, thereby gradually paralleling steam roads which resulted in several instances in the abandonment of local passenger trains on those steam roads. In discussing the influence on railways to be built in the future, the question arises whether the electric roads can be operated more economically, in which lies the gist of the whole matter; the apparatus necessary would be forthcoming at once from any of the leading manufacturers. He points out the advantages which electricity offers over steam, all of which are already well understood, referring more particularly to the more economical steam plant and the smaller capacity of a central station over a large number of separate generators in the form of steam locomotives; the difference he estimates at 25 per cent. for say a 20,000-hp plant for 40 trains; the simplicity of the rotary motion as compared with the reciprocating motion is pointed out; the electric locomotives on the London underground railway ran 60,000 miles without one cent for repairs; the absence of reciprocating motion means less wear, steeper grades, lighter roadbeds and bridges; furthermore the traction is obtained by a paying load if motor cars are used; the possible speeds are far beyond that at which the public would care to travel. He compares locomotives with motor cars, mentioning accumulator traction which on account of the great weight he says may be left out of consideration; after referring briefly to the Heilmann locomotive and that for the Baltimore tunnel, he concludes that it is fairly certain that the best method to be adopted is the overhead trolley system with voltages of about 1,000; regarding the voltage he states that the number of power stations and the weight of the copper will increase directly as the square of the relative decrease in the number of volts, quoting figures of Mr. Sprague for a 90-mile road with a speed of 90 miles an hour with two car units every ten minutes, in which case the weight of the copper would be only two-thirds that of the telephone conductors between New York and Boston; the table given shows the voltages for 1, 2, 3 and 4 power stations under these conditions, varying from 3,600 volts for the first to 900 for the last, for the two-wire system, and one-half of this for the three-wire system. Discussing the question why railway managers do not immediately replace steam by electricity, he mentions the inertia of the managers toward improvements which entail the abandonment of existing apparatus and discusses the economical operation of electric roads, showing that with a large number of trains at short intervals there is no question that electricity will prove more economical, but for a few trains over a long line it would not give sufficient returns on the capital invested; there is therefore a point midway between the present steam and electric systems where the two meet on a basis of equality; the greater the number of trips the greater the economy of electric traction, the governing factor is therefore the nature of the traffic; the successful introduction of electricity on steam roads will probably require a change in the methods of handling the passengers and freight, the single car or small train at frequent intervals taking the place of the long train. In conclusion he believes that steam railways will be eventually operated electrically; he adds that cheap transportation is the more important element, speed being secondary in most cases; according to Prout the passenger traffic on the steam roads of the United States pays 2.14 cents per mile while trolley roads carry passengers from five to 20 miles for five cents and make it pay.

Electric Street Railway Test.—No. 9 of the "Technograph" (1895) (an annual published by the Engineering Societies of the University of Illinois), contains an article by Messrs. Trego and Goldschmidt which gives a full account of efficiency tests made by them of the street railway connecting the towns of Urbana and Champaign in the State of Illinois. The railway is a single track, single trolley road of six and a half miles total length; the electrical equipment is Westinghouse throughout; seven single motor cars are operated. Several preliminary tests made in the winter of 1894 were followed in the spring of the same year by a general test of the entire plant, lasting 11 hours; the following are some of the results obtained: Water evaporated per pound of coal 4.9 pounds; cost of coal per pound of water evaporated 0.0184 cents, per passenger carried 6.46 cent, per engine hp hour 0.854 cent, per generator hp hour 1.213 cents, per motor hp hour 1.3 cents; boiler efficiency *low;* station efficiency 69.4 per cent.; line efficiency 94.6 per cent.; commercial efficiency 47.1 per cent. The article is quite long and contains nine large plates giving the data of the road and tests.

Transportation for the Paris Exhibition.—The "St. Ry. Gaz." gives a brief description of what is being done, from which it appears that electric traction will not form an important part; it is stated that the project for the underground electric road in Paris appears to have been abandoned partly because the time for completing it was insufficient.

Locomotive.—An illustration and a brief description of the one used at La Beraudiere, France, for mining purposes, is given in the "Elec. Eng.," May 1.

Successor of the Railway.—The article from the "Pop. Sc. Mo." abstracted briefly in the Digest, April 13, is reprinted in part in the "St. Ry. Gaz.," April 27.

Chicago.—A well illustrated description of the plant for the elevated railway is published in the "St. Ry. Gaz.," April 27.

A well illustrated description of the California avenue power station is published in the "West. El.," May 4.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Lighting of Trains.—The Lond. "Elec. Eng.," April 19, publishes the first part of a serial by Mr. Weekes in which he enumerates the requirements, classifies the systems, and proceeds to describe examples of these various systems and their variations, from which he intends to draw conclusions. In the present portion he begins with the systems in which accumulators placed on each car are charged by a dynamo in the baggage car driven from the axle; as an instance of this system he gives a description with good illustrations of the system of Mr. Lewis (American), the description being taken from a recent paper by Mr. Leonard read at the Society of Railway Superintendents. Comment is reserved until the other descriptions are given. The subject of train lighting is also discussed editorially in that journal.

Cost of Electric Energy for Private Installations.—In a communication to the Lond. "Engineering," April 19, Mr. Langdon gives some explanations and the data from which deductions were made in the previous issue (see Digest last week) and gives in addition some further tabular data regarding several of the stations.

Lighting Installations for Railway Stations.—A paper of a general character by Mr. L'Hoest is published with the discussion in the "Bull. l'Ass'n Ing. El. Montefiore," vol. 6, Nos. 1, 2, 3.

Light and Power Installation in a Brewery.—A description with illustrations of a plant in a large brewery in Zipf, is published in the "Zeit. fuer Elek.," April 15; it includes a small trolley road for freight purposes in connection with which a table is given containing experimental data regarding the load, power and speed.

Charging for Current.—In a brief article on the management of central stations in "L'Energie Elec.," April 16, methods of charging are briefly discussed and an illustrated description of the cut-out of M. Sageret is given; 300 of these instruments are in use at Rouen; by means of an additional fine wire leading to the station this interrupter enables the current to be cut off from any consumer at any fixed time by the attendant at the station.

Electricity in Relation to Fire Risks.—In Lond. "Lightning," April 18, Mr. Clirehugh discusses briefly the reasons why insurance companies have not reduced the premiums for electrical installations; the chief reason is probably that electric lighting has become so common that it will soon be in most of the buildings and therefore to reduce the rate would signify a lowering of the rates all around; the second is that the companies are afraid of electricity, which is due greatly to careless workmanship; he states that there is more unsafe work being done now than ever before.

Stage Lighting.—The apparatus of Siemens & Halske for varying the brightness of the lights in different groups for stage lighting, is briefly described and illustrated in the "Zeit. f. Beleucht," April 15.

Central Station Statistics in Switzerland.—A long table giving briefly some data for each station, taken apparently from an official publication, is reprinted in the "Zeit. f. Beleucht," April 15.

Electrical Industry in London.—The Lond. "Elec. Eng.," April 19, translates an article by Mr. Semenza from "L'Elettricista" for November in which he gives his views (from the standpoint of an Italian) of the electrical industries in London.

Budapest.—A description of some length without illustrations, of the station at Budapest is given by Mr. de Fodor in the "Zeit. fuer Elek.," April 1 and 15, and is to be continued.

Edinburgh.—A description of this station which has just been opened, is published in Lond. "Lightning," April 18.

Sunderland.—An illustrated description of this alternating current station is published in Lond. "Lightning," April 11.

Aberdeen.—The accounts of this station for the past year are published in the Lond. "Elec. Eng.," April 19.

Multiphase Plants.—The "Elec. Eng.," May 1, gives a brief description of the two-phased 300-kw plant at Fitchburg and a small three-phased plant for mining purposes in the tropics.

Effective Electric Lighting.—Mr. Maycock's article mentioned in the Digest, April 27, is being reprinted in the "Elec. Rev." beginning with the issue of May 1.

Portable Plant.—An illustration of the 28-arc light plant used for the Buffalo Bill show is published in the "Elec. Rev.," May 1.

Electricity at the Atlanta Exposition.—A short article on this subject by Mr. Atkinson is published in the "West.. El.," May 4.

WIRES, WIRING AND CONDUITS.

Underground Mains.—The Kingdon system is described and illustrated in the Lond. "Elec. Rev.," April 19. The object is to avoid the risk of explosions by the accumulation of explosive gases in the conduits; each main is laid in a channel iron shaped like the letter U inverted, the iron therefore protecting the cable against mechanical injury from above; the size of the iron is such as to approximately fit the cable; the bottom of this channel iron is closed by means of a strip of wood or iron forced into it. For alternating currents both cables are laid in the one channel iron or a concentric cable is used. The cost of this system is said to be no greater than that of armoring the cables with steel ribbons and the ease with which the channel can be removed for the purpose of making joints is an additional advantage.

St. Pancras Explosion.—The Lond. "Elec. Rev.," April 19, comments unfavorably and at some length on the recent Board of Trade report regarding this explosion; it expresses great disappointment at the nature of the report.

ELECTRO-PHYSICS AND MAGNETISM.

Mechanical Equivalent of Light.—In a short paper by Mr. Ravenshear in the Lond. "Elec. Rev.," April 19, he calls attention to the want of constancy in the energy equivalent of light and claims that from a theoretical point of view a candle power has no fixed mechanical equivalent, giving an attempt to show this by means of a simple geometrical diagram; in this he takes a system of three co-ordinates, making one proportional to the mass of each vibrating atom in a luminous body, the other represents the squares of the number of vibrations per second executed by successive atoms, and the third, the squares of the amplitudes; the whole volume of the solid drawn on this system of co-ordinates therefore represents the energy of vibration of the whole body. Making the usual assumption that a physical candle power is proportional to the mean of the squares of the amplitudes, the candle power will in this diagram be the mean height of the prism corresponding to the visible spectrum; if the condition is imposed that the luminous energy has to bear a constant proportion to the candle power, the supposition must be made that the law of displacement of the atoms is identical with Hooke's law and that unless this extremely unlikely assumption holds good, the physical candle power of the source of light is not proportional to the luminous energy; if the candle power is not in a constant ratio to the luminous radiation it has not a fixed mechanical equivalent. He concludes that all such quantities as the ratio of the candle power to the luminous energy, or that of the luminous energy to the total energy, or that of the candle power to the total energy, by any of which the efficiency of a source of light might be measured, have none of them constant values even for the same source of light at different intensities; Merritt examined the first and second, Thompson used the second and Ebert seems to have used the third with his luminous lamp; there is no wonder therefore that the results are discordant.

Earth Currents.—"L'Eclairage Elec.," March 30, contains an article by Mr. Palmieri giving the results of his observations on Mt. Vesuvius. Those who have made observations with earth currents have usually run the wires horizontally and none of them, to his knowledge, have taken into account the vertical inclination of the wires; in the present tests the wires were run from the foot and near the top of the mountain and covered a period of six years. From his results he draws the following conclusions which he considers are demonstrated by the facts observed; in inclined wires the earth currents flow from the lower to the upper end whatever be the inclination; this supposes that the experiments were made beyond the volcanic regions or in the present case, when the volcano is not in action; if the volcano is in action the intensity of the currents diminishes or increases according as the activity of the eruption increases or diminishes; the variations depend on the activity of the volcano; researches with earth currents, not in volcanic regions, should be made with perfectly level wires and also with those inclined.

Photographs of Sparks.—"L'Energie Elec.," April 16, describes a simple process for photographing sparks from influence machines and gives two good reproductions, one of a positive and the other of a negative discharge showing distinct characteristics; they were made by Mr. Farman; the method is as follows: a sensitive plate is placed on a horizontal copper disc somewhat smaller than the plate and separated from it by a sheet of black paper the size of the copper disc, to avoid reflection from it; one knob of the machine is placed over the sensitive plate and in contact with it while the other is connected with the copper disc; the spark therefore travels readily from the centre of the sensitive plate and is photograped by its own light; the pole over the sensitive plate should terminate in a point; excellent results are said to be obtained with this simple apparatus.

Law of the Dissipation of Energy in Dielectrics.—A translation from the Italian, in abstract, of a paper by Mr. Arno is given in the Lond. "Elec. Rev.," April 19; he refers to electric fields of feeble intensity and gives the numerical constants which he determined empirically. In conclusion he draws an analogy between the law of the magnetic hysteresis and the law of the phenomenon which he has been studying, and which analogy, he says, confirms the idea that phenomenon is due to an electrostatic hysteresis of dielectric bodies.

Force Acting at the Surface of Separation of Two Dielectrics.—A translation of the recent paper by Mr. Pellat, mentioned in the Digest, Dec. 8, is published in the Lond. "Elec. Rev.," April 19.

Behavior of Certain Bodies in the Presence of Electromagnetic Oscillations.—A note by Prof. Minchin forming part of the discussion of Mr. Appleyard's paper on "Dielectrics" (see Digest, Oct. 27), is published in the Lond. "Proc. Phys. Soc." for January.

Dynamical Theory of the Electric and Luminiferous Medium.—"L'Eclairage Elec.," April 6, contains the first part of an article by Prof. Poincare on the theory of Larmor (Proc. Roy. Soc., vol. 54, p. 439). He gives a summary of the reflections which suggested themselves to him by the reading of that paper, and which he says often lead him to differ from that writer.

The Potential of an Electrified Surface.—An Academy paper by Mr. Andrade, of a mathematical nature, is reprinted in "L'Eclairage Elec.," March 30.

Mechanical Actions of Electromagnetic Origin.—An article by Mr. Weber from the "Wied. Ann.," vol. 54, p. 30, is abstracted in "L'Eclairage Elec.," April 6.

Electromagnetic Induction in Plane, Cylindrical and Spherical Current Sheets.—A paper by Mr. Bryan (see Digest, Sept. 15), is published in the Lond. "Proc. Phys. Soc." for January.

Coefficient of Induction of Multiple Conductors.—"L'Eclairage Elec.," April 6, contains an article by Mr. Guye in which he shows how the coefficient of induction can be calculated for the general case of multiple conductors.

Supposed Magnetic Fatigue.—The Lond. "Elec.," April 19, contains a short paper by Messrs. Campbell and Lovell in which they give the results of their tests. Prof. Ewing showed in a recent paper (see Digest) that there was no perceptible change in the magnetic qualities of good wrought iron when subjected to many reversals of small magnetizing fields; the present authors show that the same is true with strong magnetizing fields as also with cast iron. One series of tests was made

with a laminating wrought iron ring the magnetizing force being carried up to about 80 and the method being like that used by Ewing; the tests were made at the beginning and end of about three weeks during which interval of time the alternating current was flowing through the coils; the curves plotted on the same sheet were found to be practically coincident; with the cast iron there was a large amount of hysteresis but the hysteresis loss remained absolutely unchanged; the ring was also tested as a transformer, the results leaving no doubt that it behaved in exactly the same manner under oft repeated reversals as before.

Magnetism of Nickel.—A paper by Mr. Nagaoka on "Distribution of the Magnetization in a Wire of Nickel Under the Simultaneous Action of Longitudinal and Torsional Strains" from the "Weid. Ann.," vol. 53, p. 481, is abstracted with some curves in "L'Eclairage Elec.," March 30; a mention of this paper with the conclusions was given in the Digest, Feb. 9.

Effect of Magnetization on Length.—A paper by Mr. Nagaoka on "Variation of the Length of Elipsoids of Iron, Nickel and Cobalt Under the Influences of Magnetization" from the "Weid. Ann.," vol. 53, p. 487, is abstracted with a number of illustrations in "L'Eclairage Elec.," March 3.

Design and Winding of Alternating Current Electromagnets.—The complete paper of Prof. Thompson and Mr. Walker, abstracted in the Digest, June 2, 1894, is published in the Lond. "Proc. Phys. Soc." for January.

Experiments on Electromagnets.—In the "Technograph" for 1895 (an annual published by the Engineering Societies of the University of Illinois), Mr. Esty gives some experimental data on a standard solenoid brake magnet of the type used on electric cranes, hoists, etc. The object of the investigation was to render the design of this type of magnet (having an air gap in the magnetic circuit) less a matter of trial and guesswork; accordingly a large number of observations were made to determine the relation between ampere turns, magnetic induction, leakage, length of air gap, and the pull in pounds. Detail sketches of the magnet and connections, tables of results and a number of curves plotted therefrom including the and $\mathfrak{C}$ curve for the iron, are given. A ballistic galvanometer enclosed in a thick cylinder of iron, as a magnetic screen, was connected by a special switch to the several exploring coils around the magnetic circuit, thus giving the respective inductions; calibrated spring dynamo meters were used to measure the corresponding pulls; currents ranging from .25 to 4 amperes were sent through the magnet windings and data observed for eighteen different air gaps from 0 to 5 inches. The diameter of one magnet core was two inches; the greatest pull recorded was 1,270 pounds with no air gap and a magnetizing force of 26,825 ampere turns, the pull under working conditions being about 300 pounds with an air gap of three-eighth inch and about 18,000 ampere turns. A group of curves for various air gaps showing the relation between the pull in pounds and the $\mathfrak{B}$ in the air gap shows that for small air gaps pull (in pounds) $= \frac{\mathfrak{C}^2}{11{,}740{,}000}$ or $\mathfrak{B} = 3{,}426\sqrt{\text{pull}}$, the curves approximating to rectangular hyperbolæ. Another curve shows how the coefficient of leakage varies with the air gap, the calculated and experimental values of the former agreeing fairly well. It was found that varying the ratio $\frac{\text{length of fixed cores,}}{\text{length of movable cores,}}$ made practically no difference in the results. To the designer of similar types of electromagnet, the data given will be of great service for predicting the pull to be obtained under varying conditions of magnetizing force, magnetic induction and length of air gap. The article is quite long and contains numerous tables and curves.

ELECTRO-CHEMISTRY AND BATTERIES.

Metallurgy of Copper.—In an article by Dr. Cohen and Mr. Lenz in the "Zeit. f. Electrochem," April 20, they discuss the subject of the electrolysis of copper from cuprous chloride without the use of a diaphragm. They give a brief review of experiments in this direction with special reference to the method of Hoepfner in which a diaphragm is necessary. (The advantage in using cuprous chloride solution is that the same current will deposit twice as much copper as in the ordinary copper sulphate solution or any other cupric solution thus representing a great economy in power; besides this there is the advantage that the chloride solution at the same time extracts all other valuable metals in the ore and it is much more soluble, thus requiring smaller apparatus.) They show that the reason for the failure of the Hoepfner method was due to the use of this diaphragm and they describe experiments made by themselves which show that the cupric solution which is formed in the process sinks to the bottom of the vats where it can be drawn off with a siphon; in the presence of the cupric solution the deposit of copper is again partially dissolved; the copper electrode in this system extends only half way down to the bottom of the vats while the annode of carbon extends to the bottom; the results are said to have been excellent, the weight of the copper deposit being 1.91 times as great as that in sulphate solutions; the current density affects the result but slightly; the degree of concentration, however, has a very important influence; they give figures showing the results of experiments to determine the best concentration; with the apparatus which is described and illustrated the action was continuous, the cuprous solution flowing in at the top and the cupric flowing out at the bottom.

Electrometallurgy of Zinc.—According to the "Zeit. fuer Elek.," April 15, an installation was started in Duisburg in which the zinc was extracted directly from the ore by being heated in an electric furnace; no further information is given. The electrolytic process of Nahusen is referred to, which has been used for several years in another installation, but it is only for obtaining small quantities as the cost of the installation is greater than that of the ordinary process, although the zinc obtained is very much more pure.

Electrolysis.—Dr. Keith in a communication to the Lond. "Elec. Rev.," April 19, continues the discussion of his recent paper; it is largely personal; he adheres to his definition and use of the word "electrolysis."

The Hermite Process of Disinfection.—According to a paper by Messrs. Roscoe and Lund, before the Chemical Society of London, there is no complete sterilization produced by electrolyzed sea water although it deodorizes, and the method is therefore not adapted for disinfection purposes; if the liquid contains less than 0.5 gram of chlorine in a liter it rapidly loses all this in contact with the solid material encountered; if the percentage of chlorine is greater it will remain nearly constant.

Disinfection of Sewers.—A report to the city of Bombay abstracted briefly in the Lond. "Elec.," April 19, states that it would not be possible to introduce the system of electrolyzed sea water (the Hermite system) for disinfection on a large scale in that city, except at a heavy initial outlay; the report looks upon the introduction of the system as an experiment and doubts whether it is worth the expenditure.

Cost of Operating a Chlorine and Soda Installation.—The "Zeit. f. Electrochem." contains a paper by Mr. Haeussermann in which he gives in detail and discusses, an estimate of the cost of operating a plant for producing daily 11,000 pounds of sodium-hydrate and the corresponding amount of chloride of calcium, from the electrolysis of a solution of salt; the figures are not based entirely on results obtained in practice. Eight hundred and thirty-two electrical hp will be required; the cost of the whole installation is given as $144,000; the following are the costs per day in dollars: power 110, salt 29, coal 22, lime 27, packing 51, labor 44, repairs 42, amortization 55; total 380; to this should be added all the necessary general expenses which he estimates at 25 per cent. of the total operating expenses.

Chlorine and Soda.—An illustrated description of the Kellner apparaus is published in the "Zeit. f. Electrochem.," April 20; there is a layer of mercury which by means of a bell-shaped cover is shifted alternately into the apartment where electrolysis takes place and into the other apartment where the amalgam is decomposed; the mercury itself remains at rest.

Electrochemical Industry.—"L'Elec.," April 20, contains a short article by Mr. Andreoli in which he points out quite a number of errors in the recent paper of Mr. Lucion (see Digest, March 16); it appears that in a number of cases the latter referred to installations which have long ago been abandoned and processes which do not exist, besides making other mistakes; any one who has read that paper should not fail to read these corrections of Mr. Andreoli. He adds a few remarks regarding the bleaching of sugar by means of ozone, which in a recent paper by Mr. Buse was said to be done in an installation in Lancaster; such an installation does not and never did exist; there are a number of reasons why sugar will never be bleached by ozone chiefly because there is no need of using ozone of which great quantities would be required; ozone would be too expensive.

Dry Pile.—A new pile by Mr. Renault is briefly described in "L'Elec.," April 20; it is made of a vessel of carbon in the bottom of which is placed chromic acid mixed with silica gelatine which absorbs 60 times its volume of water; above this is a disc of porous earthenware on which is a spiral of zinc surrounded by silica gelatine; it is said to have great capacity in a very small volume.

Thermochemical Carbon Cell.—The paper of Mr. Korda abstracted in the Digest last week, is given apparently in full in "L'Ind. Elec.," April 10, "L'Eclairage Elec.," March 30, and "L'Elec.," April 13.

Solubility of Sulphate of Lead.—The Lond. "Elec. Rev.," April 19, quotes an experiment by Mr. Burman confirming the conclusions of Gladstone and Hibbert that sulphate of lead is about equally insoluble in dilute sulphuric acid and in dilute acid mixed with sodium sulphate.

Limits of Electrolysis.—The Lond. "Elec. Rev.," April 19, gives a brief abstract of the recent paper of Mr. LeBlanc abstracted in the Digest, Dec. 29.

Chemical Analysis by Means of Lighting Currents.—An apparatus for using lighting currents for chemical analysis is described and illustrated in the "Zeit. f. Electrochem.," April 20.

Electro-Chemistry.—The electro-chemical journals occasionally contain articles which are of interest to chemists only and not to the electrical engineer; such articles will therefore not be noticed in the Digest.

Action of Electric Currents on Fused Sulphurets.—A translation of Mr. Garnier's paper (abstracted in the Digest, March 9 and 23), is given in the "West. El.," May 4.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Scale Photometer.—The "Zeit f. Beleucht," April 15 contains an article by Mr. Delman in which he discusses the eye as used in photometric measurement and gives an illustrated description of the Zoellner scale photometer which is based on the proposition of Crookes; it consists of a Crookes radiometer made of four vanes of mica blackened on one side and suspended in a vacuum tube on a strong cocoon thread;

light falling on this radiometer will tend to turn it in proportion to the intensity of the light; the deflection is measured on a circular scale; the instrument is mounted so that it can be turned on a vertical axis. The instrument was described in 1879 but has not come into extended use; it is believed, however, that as the measurements of lights of different colors is becoming important, the instrument will now come into use; it may be used to advantage by photographers to determine the degree of light with which they are printing plates, the instrument being placed in the same light and the readings taken directly; experiments in this direction gave very favorable results; the temperature has quite a marked influence on the deflection and it is therefore necessary to use a thermometer in connection with it.

Aperiodic Galvanometer.—A new instrument devised by Messrs. Chauvin and Arnoux is described and illustrated in "L'Ind. Elec.," April 10. It appears to consist of a small d'Arsonval galvanometer (like the Weston instrument) except that the movable coil is circular and about the size of an ordinary finger ring; it is said not to change its constant as the magnetomotive force developed in the coil is very small, being only about two ampere turns for a deflection over the whole scale. They are made in the form of voltmeters and amperemeters; in the latter the instrument is shunted with a conveniently arranged resistance separate from the instrument and which may therefore be changed to increase the range.

Sensitive Galvanometer.—A Physical Society paper by Mr. Weiss is abstracted briefly in "L'Eclairage Elec.," April 6. Instead of using very short magnetic needles which are difficult to magnetize and which exercise a demagnetizing action on each other, he makes an astatic system of two long vertical magnets fastened on a piece of mica; such system is always astatic whatever be the intensity of magnetization of each of the magnets; the magnets are long with respect to the distance apart; each pair of ends is at the centre of cylindrical coils like in the Thomson galvanometer; by properly reducing the dimensions, a galvanometer is obtained whose construction is very simple, and which is claimed to have a greater sensitiveness than any other known form.

Effect of an Alternating E. M. F. on the Capillary Electrometer.—An Academy Paper by Mr. Brunhes is given briefly in "L'Ind. Elec.," April 10; he describes some experiments.

Absolute Electrometers.—A Physical Society paper by Messrs. Abrahams and Lemoine briefly describing an instrument for measuring 40,000 to 100,000 volts, is published in "L'Eclairage Elec.," April 6.

The Hookham Alternate Current Meter.—The Lond. "Elec.," April 19, publishes a well illustrated description; it consists of a Ferraris motor controlled by an electric brake.

Cinemograph.—An electrical instrument with this name, intended for registering velocities, that is, the distance passed over in a unit of time by a moving body, made by Richard Bros., is described at some length and well illustrated in "L'Elec.," April 20.

Influence Machine.—A new form devised by Mr. Lebiez is described and well illustrated in "L'Elec.," April 13; the construction is said to be extremely simple and cheap; the principle is the same as that of the replenisher of Thomson and its output is equal to that of the well-known Wimshurst machines.

Resistance Wire for Strong Currents.—A translation of Mr. Stiecker's paper which was abstracted in the Digest, Nov. 3, is published in the Lond. "Elec. Rev.," April 19; he points out the error in the recent conclusion of Messrs. Herzog and Feldmann in which they attempted to show that copper and iron are better adapted for rheostats than high resistance wires.

Measuring the Insulation Resistance of Leads While in Use.—A short paper by M. de Bast published in the "Bull. l'Ass. Ing. El. Montefiore," vol. 6, Nos. 1, 2, 3, describes the following method the equations for which are deduced in the paper. A voltmeter is used for measuring the total insulation resistance of a network of wires of a three-wire system while in use; let the resistance of the voltmeter be r; connect it between one of the outside wires and the earth and let the reading be a; connect it in the same way between the other outside wire and the earth and let the reading be b; connect it between the two outside wires and let the reading be c; then the insulation resistance of the whole circuit will be equal to

$$r\left(\frac{C}{a+b}-1\right).$$

Photographic Testing of Projector Reflectors.—A number of illustrations from the recent article of Mr. Tchikoleff, mentioned in the Digest Feb. 16, together with a brief description, are reproduced in the Lond "Elec. Eng.," April 19.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Code Telegrams.—A writer who is quoted in the Lond. "Elec Eng.," April 19, criticises very unfavorably the recently proposed international code showing that a number of English words exist in it which differ in only one letter; he states that the vocabulary reflects but little credit on those who prepared it and argues that such an ill-selected vocabulary should not be forced on the mercantile communities of Europe.

Submarine Cable.—A discussion of the proposition for a cable from Tamatave to the island of Maurice is published in "L'Elec.," April 13.

Indicators and Regulators.—"L'Industrie," April 14, in a report on the Antwerp exposition contains an illustrated description of indicators of water levels, regulators for clocks and microphone.

Longest Telephone Wire Span.—According to the "Elek. Anz.," April 14, a telephone wire was recently stretched across the Walensee, Switzerland, the length of the span of which is 7,900 feet which is doubtless the longest span in the world; one support lies 1,180 feet above the lake; the wire is 2 mm in diameter (about a No. 12 B. & S.).

Submarine Cables.—In a continuation of Capt. Trott's article in the "Elec. Eng.," May 1, he explains some of the methods of repairing broken cables; he states that the steamship Minia made 120 repairs during the last 10 years without a sirgle failure although some were at the enormous depth of 2,597 fathoms, a record which is claimed to be without a parallel.

Telephone Competition.—The "West. El.," May 4, publishes a number of extracts from daily papers concerning telephone competition.

MISCELLANEOUS.

Therapeutic Action of High Frequency Currents.—An abstract of an Academy paper of Messrs. Apostoli and Berlioz is given in "L'Ind. Elec.," April 10. During the past year they treated a large number of patients with high frequency alternating currents generated in the body itself by induction, as originally suggested by d'Arsonval, who termed the process auto-conduction (described in the Digest, Aug. 5 and 12, 1893; March 17 and April 28, 1894); the patients were surrounded by a large solenoid and treated every day for 15 to 20 minutes, the treatment being as nearly uniform as possible. In conclusion they claim that their numerous results confirm the physiological action discovered by d'Arsonval; these currents have a powerful influence on the nutritive action and therefore constitute a means of medical treatment of the first order in a large number of functional diseases due to improper nutrition. In "L'Elec.," April 13, the results are given more in detail, those in which the treatment was successful as well as those in which it was not; the total number of treatments on which these conclusions were based amounted to 2,446.

Artificial Indiarubber.—According to the "Rev. Scientifique" (no date given) Mr. LeBrocquy makes artificial rubber with a mixture of glue, glycerine and molasses.

Insulating Material.—According to the "Zeit. f. Beleucht.," April 15, Mr. Gentzsch makes a new insulating material from mineral substances like ozokerite, asphalt or amber, which are heated to 400 degrees C. until all steam, gases or oils cease to be evolved; what remains has the consistency of butter and can be used either alone or mixed with other materials.

Calcium Carbide.—According to the "Elek. Anz.," April 14, the Aluminium Company at Neuhausen, Switzerland, has begun the manufacture of this material and sells it at 5.5 cts. per pound; (this is from 1-9 to 1-5 of the price at which it is quoted in New York city.)

Lightning.—According to the "Zeit. fuer Elek.," April 15, a photograph of a stroke of lightning which occured in Prague in May last year showed six distinct bolts originating from one cloud and extending in different directions striking four houses, a cupola and telephone wires; a peculiar phenomena was noticed, the photograph showed very distinctly the shadow of the cupola on the dark sky. (It is not quite clear how the same photograph can show the lightning and at the same time the shadow of the cupola on the sky unless the lightning was between the camera and the cupola which, though possible, seems hardly likely; there ought to have been six shadows.)

Educational.—The Lond. "Elec. Eng.," April 19, publishes the answers and solutions to the questions in electric lighting and power transmission, in the preliminary examination of the City and Guilds of London Institute.

Patent Decision.—The "Eng. Mag." for May contains an article b Mr. Benjamin on "The Meaning of the Recent United States Patent Decision," referring to the Bate case, in which he points out that the law in this case defeats its own object; the persons that were aimed at were the foreigners and its principal effect has been to limit the life of American patents of American inventors; the statute referred to, he claims, does not serve any beneficial purpose.

A Complete Telephone System.

We illustrate herewith some of the telephone apparatus of the Western Telephone Construction Company, Monadnock Block, Chicago, Ill. This company, which has been furnishing telephone apparatus for the last three years, is the oldest manufacturer in the United States in competition with the Bell Company, and owns or controls many patents relating to details of construction. Fig. 1 shows the new "Western Giant" long distance and exchange telephone, with granular carbon microphone transmitters. Granular carbon held between carbon discs forms the electrodes of the microphone. The discs are held in a cast brass shell fitted with a thread-like projection which passes through the box, and to which is screwed the mouthpiece, so that it can be used as an agitator, thus keeping the granules in a free state. This instrument is constructed with a view to avoiding the great care usually required by microphone telephones, and does not, therefore, need the constant tinkering incident to the usual types. The carbon granules and their arrangement are such as to prevent "packing" and injury in other ways. A switchboard form of transmitter is shown in Fig. 2.

The receiver is of the double pole type with double compound bar

magnets, and the highest guarantees as to its efficiency are offered by the makers. The telephone hook is also guaranteed free of patents and to be both mechanically and electrically efficient in every respect. The magneto call bells and generators, the latter shown in Fig. 3, are manufactured by the company, and not constructed, as is usual, from parts purchased elsewhere. All the connections are soldered, and no contacts

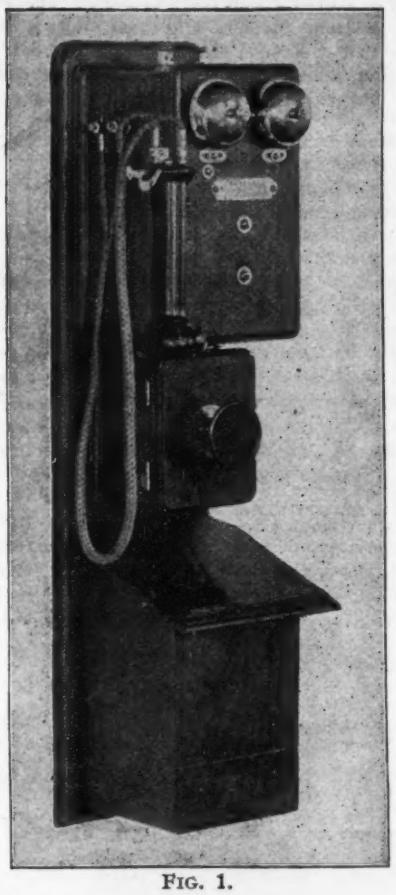


FIG. 1.

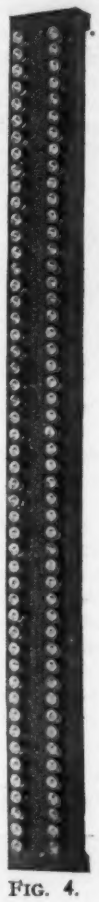


FIG. 4.

are made through hinges; the microphone circuit-changing contacts are platinum-pointed, and all contacts are strong, firm and direct, the usual rubbing contact being avoided. The best magnet steel to be purchased is used in their construction, and the armatures and bells are wound for the best efficiency.

The switchboards are claimed to be free of infringing devices, and to contain a number of features patented by the makers. The 100 connection board requires but 10 in. by 15 in. by 4 in. space, and can be placed in the waste space of an ordinary writing desk. The 300 to 500 connection board can be operated with one-third the usual number of operators; the same movement by the operator which places the plug in the jack, restores the drop. It is claimed that this board gives no chance for induction, while sections can be added indefinitely. It is equipped for both metallic circuit and single line systems; can readily be changed from one to the other. Fig. 4 illustrates one of the details of the exchange system, being a new type of cable lightning arrester and distributing board.

FIGS. 2 AND 3.

A New Insulating Compound.

A patent was issued last week to J. W. Kidwell, of Washington, D. C., for a new insulating compound, consisting of a titanic mineral such as rutile, brookite and other similar materials found in the phosphate ore of Nelson county, Va. These materials are usually found together in the ore referred to and they are conveniently so used, but either may be employed exclusively in forming the compound.

To produce 100 pounds of compound, 75 to 85 pounds of the titanic minerals are used and from 10 to 20 pounds of asphaltum and about five pounds of rice hulls, the latter furnishing the necessary silicious material, upon which the insulating properties of the compound very largely depends.

The mineral is ground to a fine powder and mixed with the asphaltum by heat and stirring, the rice hulls being added after the mixing is completed. The inventor states that a thickness of one-eighth of an inch of this insulating material has resisted a pressure of 24,000 volts.

A New Electrical Enterprise.

A new and vigorous firm is about to enter the electrical field, Messrs. Thos. E. Adams, E. J. Bagnall, L. H. Rogers, C. W. Phipps, S. E. Cox and George Arnold, for many years identified with the Brush Company, having withdrawn from that concern, and formed what will be known as the Adams-Bagnall Company.

Mr. Adams is well known as the designer of the Brush-Adams arc lamp, which has been so widely used ever since it came out five years ago, and the merits of which are due in great measure to the fact that Mr. Adams obtained, by personal interviews with trimmers and repairers, a thorough knowledge of the defects and disadvantages embodied in arc lamps generally, and then bent his energies to the avoidance of those defects in the construction of his lamp.

Mr. Bagnall was with the Brush Company for eight years, occupying a number of prominent positions. During the past seven years he has been engaged in engineering work in St. Louis, and was consulting engineer for the Lindell Railway Company, whose road was built and equipped under his supervision.

Mr. Rogers is so widely known as to make any comment here practically superfluous. He has been with the Brush and General Electric companies for six years, and has scored many and signal successes in electrical business circles.

Mr. Phipps has been closely identified with the Brush Company since a short time subsequent to its original organization, and he has been repeatedly intrusted with most important missions to foreign countries. He is a man of extended experience in the handling of large forces o men and the general supervision of factory work.

Mr. Cox made hosts of friends throughout the country during his able management of the Swan Incandescent Lamp Company's affairs, and his fine executive ability and judgment in this line of work make him exceedingly valuable to the new organization.

Mr. Arnold has successfully filled several positions of responsibility with the Brush Company, his last work being in the drafting department, of which he was in full charge.

Associated with the above named gentlemen are a number of the most influential capitalists in Cleveland, among them being Mr. Charles G. Hickox, who is president of the new company, and Mr. Geo. W. Howe, vice-president and treasurer. The other offices are filled as follows: General manager, L. H. Rogers; secretary, S. E. Cox, and superintendent, C. W. Phipps. The building formerly occupied by the Hackney Bicycle Company, at No. 47 East Prospect street, has been leased for a factory.

Nothing very definite can be stated at this time concerning the company's policy beyond the fact that arc and incandescent lamps and probably street railway motors will be manufactured.

The Manufacture of Carbon for Electrical Purposes.

An American patent was issued last week to Messrs. C. P. Shrewsbury and J. L. Dobell, of Modbury, England, on improvements in the manufacture from carbonaceous materials of plates, slabs, pencils and other articles for electrical and other purposes.

The invention consists in the production of a compound which, when subjected to the different processes of treatment, can be given different properties; according to one process a carbon insulator is produced and by another a material equal or superior in conductivity to graphite, but costing considerably less.

The compound consists of anthracite coal, bituminous coal and pitch or tar, or both; the articles which are formed from this mixture are submitted to pressure, and gradual baking concludes the process. The anthracite coal and bituminous coal are first reduced to a fine state of division and then placed in a suitable mixing machine in the proportions by weight of anthracite coal 10 parts and bituminous coal four parts; after having been thoroughly mixed a considerable quantity of tar or pitch, or both, is added, such quantity being varied according to the caking quality of the bituminous coal and the degree of pressure to be employed in forming the material into the required shape. If the bituminous coal be of good caking quality, about seven parts by weight of the above may be added and a light pressure not exceeding 20 pounds to the square inch applied. As the pressure is increased the amount of tar, etc., is less.

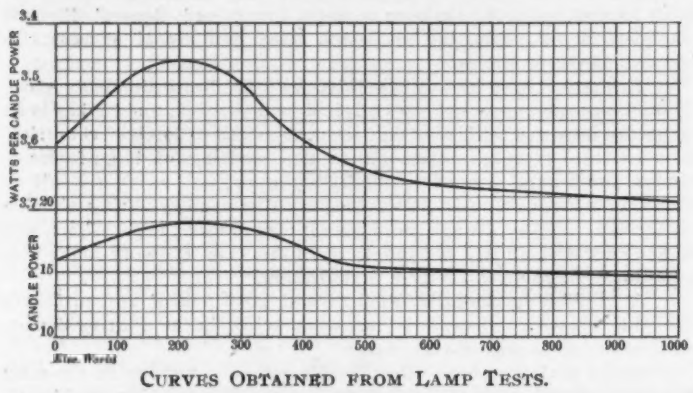
When the material is moulded under pressure not exceeding 20 pounds per square inch, it is not sufficiently condensed to retain its form during the baking process if removed from the moulds previous to being placed in the oven; it is therefore baked in the moulds, after which it is removed, and, if required to have a high electrical resistance, the article is ready for use; if, on the contrary, it is required to have a low resistance, another baking at a higher temperature is necessary.

If it is desired to produce a plate or other article to be employed as an electrical insulator, the maximum temperature must not exceed 1,450 degrees F.; if it is to possess a high electrical resistance the temperature must be above 1,450 degrees, and must not exceed about 1,500 degrees. If required for Laclanche or Bunsen batteries, the temperature

must be above 1,600 degrees F. In all cases the oven is allowed to remain at the maximum temperature for a period of about four hours. If the articles are required to be of low electrical resistance, such as that of carbon plates employed for electrolysis, or are to be subjected to a high temperature, the oven temperature should be raised to from about 1,600 to 1,800 degrees F. After the articles are removed from the moulds they are placed in tiers in an oven with ashes between and surrounding them, and the temperature gradually raised to 2,500 degrees and maintained at the maximum temperature about four hours, after which the oven is allowed to gradually cool. If, however, the material in the moulds be subjected to a pressure of 300 pounds or upward per square inch, the moulded articles before being placed in the oven may be removed from the moulds and placed in a drying chamber or dried by exposure to a dry atmosphere, after which, if the article is to be of low electrical resistance, the baking may be effected by one operation.

Recent Tests of Packard Lamps.

The accompanying curves and tables of tests made on April 30, of Packard lamps, show clearly the peculiar properties of this lamp, and



Curves Obtained from Lamp Tests.

justify the New York & Ohio Company in claiming an increase in candle-power and efficiency for the first few hundred hours, followed by a remarkable maintenance of both. An analysis of the curves shows that the candle-power gradually increases up to about 225 hours, when the maximum of nearly 19 candle-power is reached, giving an increase of nearly 20 per cent. in light. Beyond 300 hours there is a gradual decrease in candle power, but this is so gradual that the 450th hour is almost reached before the lamps have fallen back to the initial candle-power, and the drop beyond that point is so very gradual as to be practically imperceptible. This maintenance of candle-power means, of course, a longer commercial life.

The maximum efficiency is reached at about 200 hours, when the lamps show an increase of 2-10 of a watt, and the falling off in efficiency, like that in candle-power, is so gradual that not until 400 hours burning do the lamps drop back to their initial efficiency, and even at 1,000 hours the tests show only a drop of 1-10 of a watt in efficiency. These lamp tests show an unusually efficient filament treatment, and it is said that the carbon is so dense that it stands continuous use without showing any signs of deterioration, which gives the lamps another desirable feature, as the bulbs do not, even after 1,000 hours, show any appreciable blackening.

TESTS OF PACKARD 16 CP LAMPS.
50 lamps, 98 volts, direct current.
Average measurements.

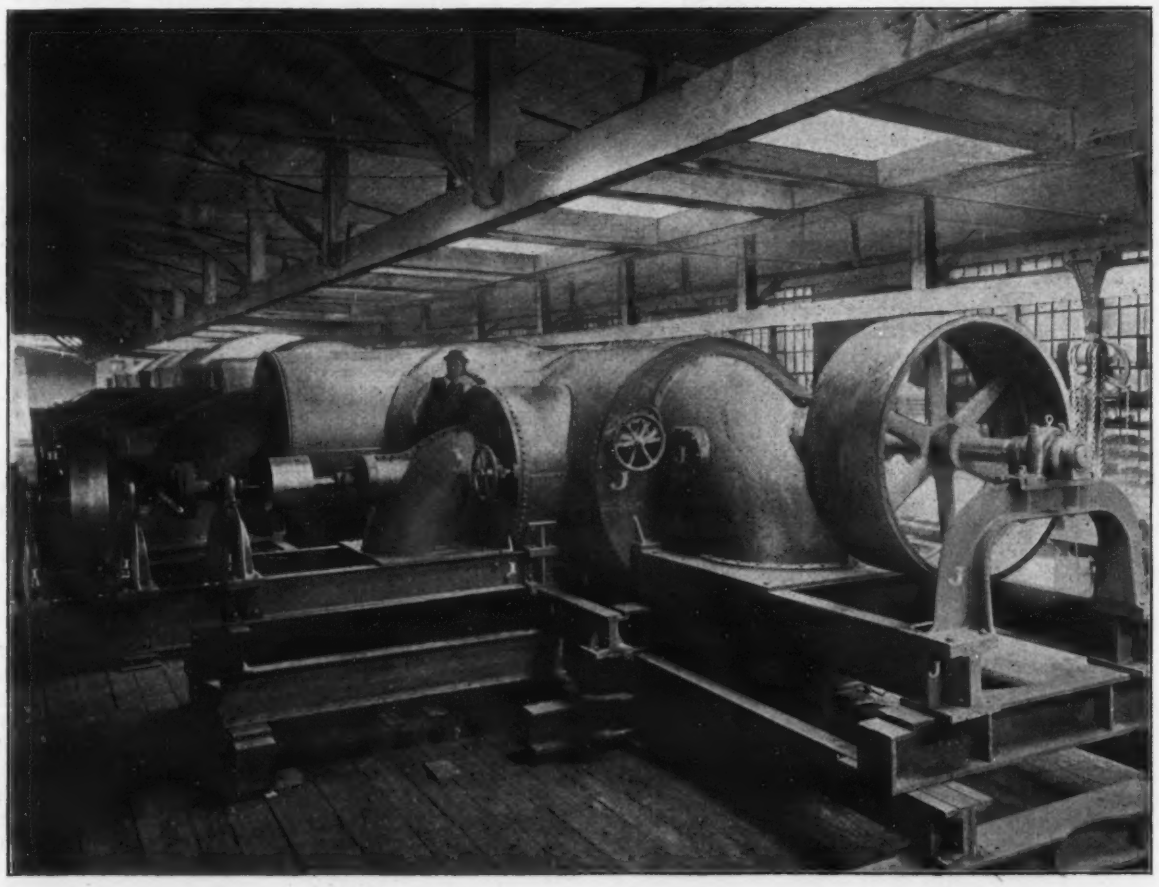
	Volts.	Current.	Watts.	Watts per cp.
Initial	98.2	.583 Amp.	57.25	3.59
End of 100 hours	97.4	.577 "	56.23	3.51
" 200 "	96.9	.578 "	55.33	3.46
" 300 "	96.8	.578 "	55.93	3.49
" 400 "	97.8	.585 "	57.21	3.58
" 500 "	99.0	.585 "	58.21	3.63
" 600 "	99.0	.589 "	58.31	3.64
" 800 "	99.3	.590 "	58.58	3.66
" 1000 "	100.1	.591 "	59.16	3.69

Increase of candle power at 98 volts.

Initial	16 cp.
End of 100 hours	17.9 "
" 200 "	18.7 "
" 300 "	18.7 "
" 400 "	16.9 "
" 500 "	15.5 "
" 600 "	15.5 "
" 800 "	15.2 "
" 1000 "	14.5 "

A Large Water Power Plant.

We illustrate a very large turbine water wheel plant recently built by the Stilwell-Pierce & Smith-Vaile Company, of Dayton, O., for driving the new pulp mill of the Freydenburgh Falls Pulp Company, Plattsburgh, N. Y. The plant consists of eight 33-inch, one 30-inch, and one 15-inch cylinder gate Victor turbines, all on horizontal shafts, and aggregating 4,660 hp All the turbines are supplied from one feeder 13 feet in diameter at its large end. The photograph was taken in the water wheel erecting shop, where the job was set up complete before shipment.



A Large Water Power Plant.

The Tracy Oil Filter.

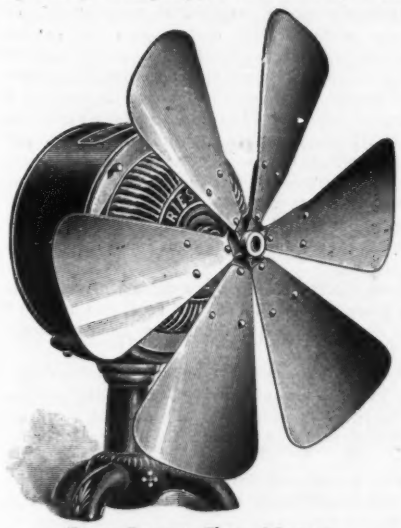
It is a well-known fact that users of lubricating oil can almost invariably realize a very material saving by the process of filtration and re-usage, and numerous devices have been produced with a view to accomplishing the filtration and purification of oil after it has passed through the journals. One of the most carefully designed filters is that manufactured by the Phœnix Automatic Filter Company, of Racine, Wis., which is shown in the accompanying illustration.

OIL FILTER.

After long and exhaustive experiments which demonstrated the unfitness of mineral wool, bone-dust, charcoal, felt, etc., as filtering mediums, owing to their so quickly becoming saturated, the Phœnix Company determined upon the method now used in its "Tracy" filters, consisting of passing the oil from a storage chamber to an accumulating compartment by means of "clarifying discs," on the capillary principle employed in an ordinary oil lamp for drawing oil up to the burner. This process is analogous to distillation, and the results have been so satisfactory that the manufacturers claim for the Tracy filters the absolute purification of lubricating oils passed through them. Additional points claimed are self-cleaning and automatic regulation.

The Ries-Scott Alternating Current Motor.

Upon the withdrawal from business recently of the Ries Electric Specialty Company, of Baltimore, Rossiter, MacGovern & Co., of 141 Liberty street, New York, purchased the Ries Company's entire stock of Ries-Scott alternating current fan motors, one of which we illustrate in the accompanying engraving. These motors are substantially built and of handsome design and finish. The armature and field cores are of unique construction, the laminæ constituting a series of very short magnetic circuits, which are almost closed.

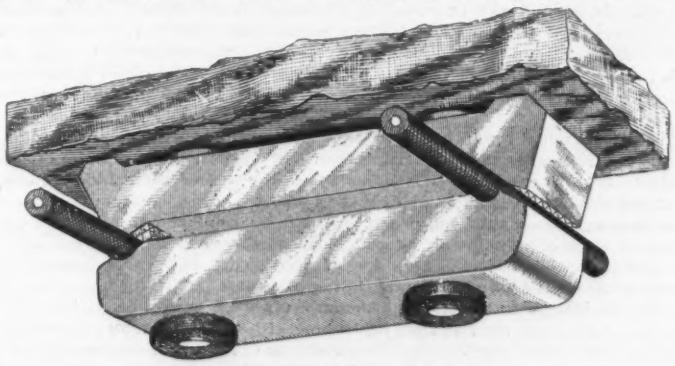


RIES-SCOTT FAN MOTOR.

The machine is provided with regulating and reversing devices and these are placed on the side opposite from the fan so as to allow manipulation of them with impunity while the fan is running. The motor is effectually cased in and protected from dust and damage, and still accessible by the removal of two screws. They are made for 50 and 100 volt circuits, and a periodicity of 133 or thereabout.

A New Porcelain Cleat.

The cleat shown in the accompanying cut is being put on the market by the Thompson-Brown Electric Company of 97 High street, Boston,

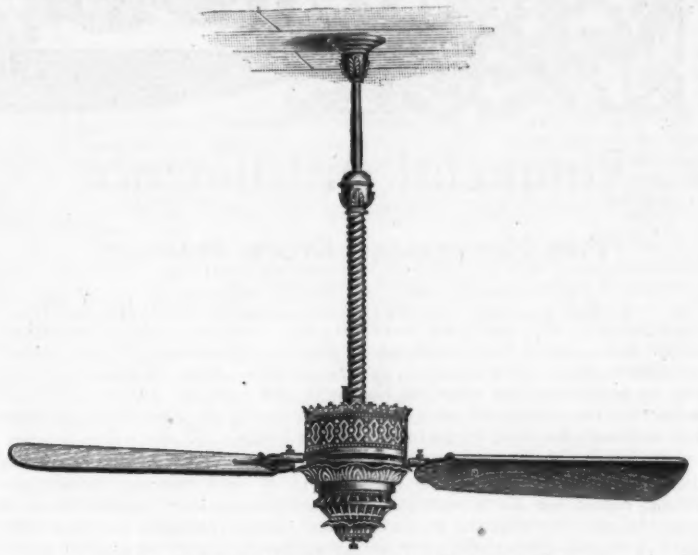


A NEW PORCELAIN CLEAT.

and will be known to the trade as the "T. B." cleat. It is made applicable to either single or double wire installation, and admits any size wire from No. 14 up. The claims made for this cleat are that it grips the wire firmly, does not at all injure the insulation, obviates the danger of the wire slipping down on the screw and causing liability to short circuit, and is moisture proof. The cleat conforms to all requirements of the underwriters, and is manufactured of the best glazed porcelain, thoroughly vitrified.

A New Alternating Current Ceiling Fan.

A new addition to the list of alternating current fan motors is the ceiling fan herewith illustrated, which is the product of the Emerson Electric Company, of St. Louis, manufacturers of the well-known Meston fan motors. The new ceiling fan is operated by a direct driving



NEW ALTERNATING CURRENT CEILING FAN.

slow speed fan motor, which runs at the rate of from 140 to 150 revolutions per minute with no greater consumption of current than is found in the ordinary desk fan motor. These fans are made up in three finishes, nickle, oxidized copper and polished brass, all of which are decidedly handsome and ornamental. The motor is provided with a special metallic brush, requiring practically no attention during a season's run. The construction throughout conforms to the high standard observed in the Meston desk fan.

Special Decorative Incandescent Lamps.

Several styles of special incandescent lamps suitable for decorative purposes are being placed on the market by the Columbia Incandescent Lamp Company, of St. Louis, two of which are shown in the accompanying illustrations. Fig. 1 represents a 16-cp coiled filament, round bulb lamp, full size, which is made in high voltages for window and ceiling decorations. These lamps may be used in a horizontal position

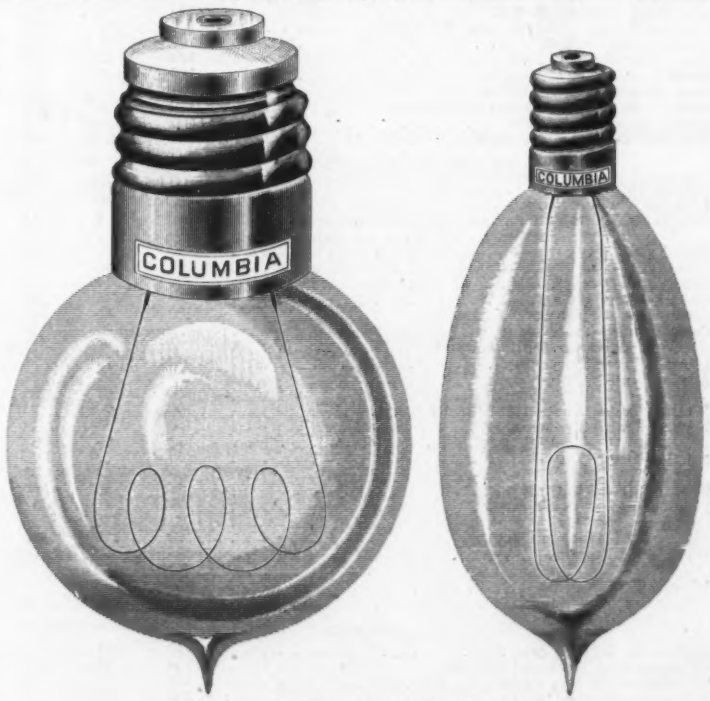


FIG. 1.—SPECIAL LAMPS.—FIG. 2.

without the disadvantage of having the filament droop to the side of the bulb. Fig. 2 shows a candelabra lamp which is made to burn, several in series, on circuits of 100 volts and upward. These lamps used with small red and yellow silk shades produce a very attractive and harmonious effect. These special lamps are said to maintain their candle-power to the same degree as the new type of standard high economy Columbia lamps, and are furnished in either ground or clear glass, as desired.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 4, 1895.

AMERICAN BELL continues to confute the numerous bearish predictions which have recently been circulated, by climbing steadily upward from 184 last Saturday to 189 at to day's closing. The explanation is by no means obvious, and the bears vouchsafe none. but look wise and intimate a "change for the worse" ere long, while the bulls cry "I told you so" in a rather uncertain manner, as though watching for an opportunity to hedge.

GENERAL ELECTRIC remained practically unchanged during the week, though it is said the stock would have gone to 40 upon the publication of the annual report but for a bear movement which has been fostered for some occult reason. For nearly a month there has been a pressure to hold the stock down, and semi-official denials of all good news. The annual report shows gross earnings of over $1,000,000 per month for 1894, and a net earning of $1,348,-164 for the whole year, of which $933,520 was charged off to depreciation, leaving $414,644 surplus. The report is given in full in the next and succeeding columns.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	96½	97½
" " " Brooklyn	100	..	108
" " " Boston	100	130	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	29¾
General Electric	100	33⅜	33⅝
General Electric, pref	100	63¼	64¼
Westinghouse Consolidated, com.	50	33¼	34
" " pref	50	52	52½

BONDS.

Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	189	189½
American District Telegraph	100	30	40
American Telegraph & Cable	100	92⅜	..
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
Erie Telephone	100	53½	54
Gold & Stock Telegraph	100	105	..
New England Telephone	100	66½	69
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	83¾	89

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	16⅝	16⅞
Binghamton RR. com	100	100	..
Brooklyn Traction	100	9	11
" " pref.	100	..	53
Buffalo St. Ry	100	66	69
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	46	49
Consolidated Traction of N. J	..	30	33
Electric Traction, Philadelphia	50	71	71½
Long Island Traction	100	11	11¼
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	90	90½
New Orleans Traction	100	15	18
" " pref.	100	56	60
North Shore Traction	100	..	..
" " pref.	100	74	83
People's Traction $30 pd	25	58½	58½
‡Philadelphia Traction	50	81¼	82
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	65¼	65¾
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	82	86

BONDS.

Buffalo St. Ry. 1st con. 5s	100	101	..
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	9	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

* With accrued interest.

‡ Ex-rights.

WESTINGHOUSE ELECTRIC also remained steady during the past week. The annual meeting of the company will, in all probability, be adjourned for a month or six weeks. The Board of Directors at their recent meeting expressed the opinion that, owing to the fact that the company has but recently become thoroughly established in its new works, and the material benefits to be derived therefrom will be much more apparent in a few weeks, it would be desirable to adjourn the stockholders' meeting until the latter part of June or early in July, in order that a more adequate showing of the importance and advantage of the new works may be then given to the stockholders.

Third Annual Report of the General Electric Company.

For the sake of greater clearness, the following report has been divided into two sections, showing:

1st. The result of liquidating the assets which appeared on the company's books prior to Jan. 31, 1894.

2d. The result of the business of the fiscal year ending Jan. 31, 1895.

As previously reported, the profit and loss statement showed on Jan. 31, 1894, a debit balance of	$12,454,967 42
The result of liquidating and providing for loss on the old assets, as explained below, has increased this by	2,754,312 27
Making the total loss on old accounts (prior to 1894) as now ascertained or estimated	$15,209,359 69
The business of the year 1894 has yielded a net profit (over interest on debentures) of	414,642 72
Leaving the present debit balance of profit and loss	$14,794,716 97

LIQUIDATION OF OLD BUSINESS.

In the last annual report your directors sought to exhibit the extent to which your company had suffered from the panic of 1893, and from other causes inherent in some of the enterprises in which it became interested at the time of its organization. Mention was made of the fact that the accounts receivable included $2,531,600.88 due by the Fort Wayne and Northwest Companies and other allied interests. Contrary to the expectation of your directors, and the statements of persons directly interested in the Northwest Company, your claim as a creditor of that company now proves to be without value; and certain other interests, inherited by your company through the Northwest Company, are also valueless. The aggregate loss from these sources is about $945,000 (viz., $456,484.43 on the account owned, and about $489,000 on other items), and this sum is included in the charges to Profit and Loss in the Supplementary Statement for the year 1893 attached hereto.

During the past year the Fort Wayne Electric Company, a former ally of one of your constituent companies, has gone into the hands of receivers, and its affairs are now being liquidated by the Court. Your company has filed with the receivers its claim for $1,137,555.48.

The balance sheet, and the schedules accompanying it, show the outstanding interests of your company as stockholder in manufacturing and other companies. Many of these securities will be sold as opportunity offers. Such a course will, in some instances, involve considerable shrinkage from former book values.

There exists also several unsettled contracts antedating the formation of your company, but which your company has to recognize, and which will cost, perhaps, $500,000 to settle.

To cover the estimated loss on all the matters above mentioned, your directors have arbitrarily charged $2,000,000 to Profit and Loss account, and the results, as shown at the head of this report, are after making this deduction.

BUSINESS OF THE FISCAL YEAR ENDING JAN. 31, 1895.

Notwithstanding the adverse conditions of the past year, the output of your various factories at cost value was only slightly below that of the previous year. The output in the amount of material produced was considerably in excess of the previous year.

Special attention has been given to the supervision of credits, economy of administration, and the improvement of factory facilities, and your directors and officers have sought to adopt every device calculated to increase the efficiency of manufacture and to reduce the cost of the manufactured product. In this they have been in a marked degree successful, and great credit is due those officers and employees of your company directly in charge of manufacturing details.

In the last annual report mention was made of the shrinkage in inventory values of electrical machinery arising from new inventions and improvements, whereby types of machinery which have been the best of their kind are often rendered obsolete. It is impossible to guard wholly against loss from this source, inasmuch as it is essential for your company to keep on hand at all times a considerable stock of manufactured goods. Such stock has been greatly reduced in the past year, and it will be the policy of your board to keep it down to the lowest point consistent with prompt filling of orders. This, together with the work accomplished in developing standard types of apparatus and supplies, warrants belief that the loss from this source will be diminished in the future.

In the last report, your directors expressed the opinion that they could, out of the then unliquidated assets, pay off the balance of your floating debt and also provide all necessary working capital. These expectations have been realized, and in addition thereto the company has purchased and cancelled $1,250,000 of its own debentures at an average cost of less than 89 per cent.

As will be seen by the statement of Profit and Loss herewith, the business of the year just closed amounted to	$13,263,611 58
The cost of goods sold, legal and general expenses and taxes were	11,451,863 98
Leaving a gross profit of	$1,811,747 60
Against which is charged interest on debentures outstanding	464,583 33
Leaving (over interest on debentures)	$1,347,164 27

There are further charged off:		
Various old losses which are difficult of division between 1894 and earlier years, and are, therefore, all charged against the year ending Jan. 31, 1895	$443,023 96	
Cost of all patents and franchises acquired or settled for during the year	162,298 11	
Depreciation of inventories	288,401 14	
Sundry losses	38,798 34	
		$932,521 55
Leaving a net profit of		$414,642 72

EXPIRATION OF THE INCANDESCENT LAMP PATENT.

As a result of the decision in the "Bate case," recently announced by the Supreme Court of the United States, it is now settled that the fundamental patent upon the Edison Incandescent Lamp expired in November, 1894. Your company still owns patents of more or less importance upon the incandescent lamp, but it will chiefly rely upon the high quality of the lamp manufactured by it and its facilities for manufacturing in large quantities at a low cost to maintain its commanding position in the lamp business irrespective of patent control. Lamp prices have necessarily been greatly reduced. While the volume of this important part of your business will without doubt be largely increased in the future, the percentage of profit thereon will necessarily be less than heretofore.

PATENT LITIGATION.

During the year the company has been successful in a number of suits in which it has been attacked by the owners of patents which it was charged with infringing. It has been defeated in no such suit. A valuable patent on the Edison form of socket has been sustained by a Court of Appeals. Several important suits on railway patents owned by the company are in progress, some of which will be argued this spring.

ENGINEERING DEPARTMENT.

The work done by the Engineering Department during the past year deserves special mention. Much has been accomplished in the development of large units, as well as in the perfection of the minor details of manufacture.

The only successful work yet accomplished in the operation of elevated roads by electricity has been done by your company, and it is now engaged in important installations of underground electric conduits for street railways.

In large power generators, in mining and power transmission work, in regulating and measuring devices, and in railway motors, the development and perfection of design have been especially noticeable.

SELLING DEPARTMENT.

The selling organization has been conducted on an efficient and economical basis, and the sales made during the past year have been almost wholly on a cash basis; the average terms of payment on all sales being 40 days after shipment.

LICENSEE COMPANIES.

These companies contribute an important part of the business done by your company in central station lighting and distribution of power, and their growth and prosperity are closely identified with the welfare of your own company. The relations which have heretofore existed between these Licensee Companies and your company continue, and the policy of your company in the future, as in the past, will be to cultivate their business and co-operate in the development of such licensees.

REDUCTION OF CAPITAL STOCK.

At the last annual meeting the following vote was passed:

"*Resolved*, That the matter of reducing the capital stock of the company in the manner prescribed by law be referred to the incoming Board of Directors, with request that they give it attention; and, if such a course commends itself to them, that they call a special meeting of the stockholders for consideration and proper action."

Your Board, after careful consideration, has deemed it inexpedient to take any action with reference thereto.

FUTURE BUSINESS.

The indications are favorable for a volume of business in excess of that last year; but prices are abnormally low, and satisfactory results will largely depend upon the ability of your company still further to reduce the cost of production and distribution of its manufactures.

PATENTS.

The $8,159,264.02 at which patents are carried is the amount at which their value was taken on pages 8 and 9 of the first annual report of your company.

AUDITOR'S REPORT.

CONSOLIDATED BALANCE SHEET.—This includes the assets and liabilities of the Edison General Electric, Edison Electric Light, and the Thomson-Houston Electric Companies, which, for convenience of bookkeeping only, are consolidated with those of the General Electric Company. The assets and liabilities of the Thomson-Houston International Electric and Pennsylvania General Electric Companies were taken over by the General Electric Company during the past year and are also included in this balance sheet.

CONSOLIDATED STATEMENT OF PROFIT AND LOSS.—This includes the profit and loss accounts of all the companies above mentioned.

ASSETS.

PATENTS AND FRANCHISES.—This account remains at the amount shown in the last two annual reports. It represents, as stated in those reports, the cost to the General Electric Company of the Edison and Thomson-Houston patents and contract rights, and its interest in the patents of the various Thomson-Houston sub-companies. During the year, $94,917.11 was expended in purchasing and taking out new patents, and $67,381 in acquiring the territorial licenses which the Thomson-Houston Company had granted to the Thomson-Houston International Electric and the Thomson-Houston Electric Light Companies, the latter being the predecessor of the Pennsylvania General Electric Company. These amounts, as well as all expenses of patent litigation for the year, have been written off to profit and loss.

MANUFACTURING PLANTS.—This account represents the real estate, buildings, machinery, tools, etc., at Schenectady, Lynn and Harrison. Their book value at Jan. 31, 1894, was $3,941,128.98. During the year $61,122.34 was expended for new buildings, and $268,079.73 for new machinery. On the other hand, $370,333.05 has been written off to profit and loss as an allowance for depreciation, leaving the present book cost of these plants $3,900,000, or $41,128.98 less than at Jan. 31, 1894.

REAL ESTATE.—This account has been increased during the year $100,098.19, chiefly by taking real estate mortgaged to secure old accounts in settlement of those accounts.

STOCKS AND BONDS.—Those securities having a market value have been taken at book values slightly under the price of recent sales. Where there is no established price it has been necessary to estimate their value from financial statements submitted by officers of the respective companies. Effort has been made to keep the book values of stocks and bonds of "local companies" down to present cash values.

There are stocks and bonds of various companies amounting to $3,500,000 at par, but of so speculative a character that they are carried at a total book value of only $82, being one dollar for each lot. Some of these latter are practically worthless, but others possess some merit and their aggregate value is likely to be considerable.

NOTES AND ACCOUNTS RECEIVABLE.—This account represents what is believed to be a conservative value of notes and open accounts of customers, after deducting and charging off to profit and loss old notes and accounts receivable of 466 debtors, not now dealt with except on a C. O. D. basis, amounting to $2,291,844.48, heretofore carried at $234,973.69, but no longer carried as assets except for the aggregate sum of $466, being one dollar for each debtor. They will be liquidated as speedily as possible.

INVENTORIES.—This account represents raw materials, goods manufactured and in process of manufacture at the works, and manufactured goods on consignment and at sales offices, all at factory cost. They have been inventoried item by item.

Reductions from the sum at which they were previously carried have been made and charged to profit and loss. The continued writing down of manufactured goods is with the intent that only standard salable apparatus shall be considered an asset.

WORK IN PROGRESS.—This account represents the amount expended on installations in progress, without any credit for the profit to be derived from such installations when completed and billed.

LIABILITIES.

CAPITAL STOCK.—To acquire five shares of common and four shares of preferred stock of the Thomson-Houston Electric Company, which had not been exchanged at the date of the last annual report, three shares of common and one share of preferred stock of this company have been issued during the year.

INDEBTEDNESS.—Pursuant to the policy announced in the last annual report, various stocks and bonds, which it was not desirable for the company to hold permanently, have been marketed. Their proceeds were placed in a special fund. The cost of all securities purchased has been charged to that fund, as follows:

Securities were sold for	1,307,298.07
Securities were acquired at a cost of	1,085,226 56
Leaving a balance	$222,071.51
To this was added from the liquidation of old notes and accounts receivable the sum of	885,996.82
Making a total of	$1,108,068.33

which was used to buy $1,250,000 of the company's debentures in the open market at an average price of about 88⅝.

By liquidating as above, and by adhering to the policy of selling for cash or on short time, the company has not only collected enough cash to retire all its floating and reduce its funded debt, but has had sufficient working capital to pay cash for all its purchases during the year.

The following comparison shows the debt of the company, other than outstanding debentures and real estate liens, on the 31st days of January, 1894 and 1895:

	1894	1895
Notes Payable	744,841.31	None.
Accounts payable, accrued interest, etc	446,307.92	494,258.01
Total	$1,190,649.23	$494,258.01
Less cash on hand	591,143.88	404,236.48
Net amount of unfunded debt	$599,505.35	$90,021.53
Paper endorsed and discounted	1,422,949.48	None.
Total	$2,022,454.83	$90,021.53.
Reduction of unfunded debt		$509,483 82
Reduction of real estate liens		26,200.00
Debentures cancelled		1,250,000.00
Reduction of debt during the year		$1,785,683.82
Reduction of endorsements		1,422,949.48
Total reduction of obligations		$3,208,633.30

PROFIT AND LOSS.

It is difficult to separate losses ascertained during the current year into those properly chargeable to this year, and those due to the errors or misfortune of previous years. The division of the profit and loss statement has been made with a view to exhibit, as far as could be distinguished, the profit of the year just ended. The losses incurred on notes and accounts, over and above the allowance made therefor last year, are due largely to diminished values of notes and accounts of customers of the Northwest General Electric Company.

GENERAL EXPENSES.

The general expenses decreased $774,832.09 as compared with the previous year.

CONSOLIDATED BALANCE SHEET, JANUARY 31, 1895.

ASSETS.

Patents and Franchises		$8,159,264 02
Manufacturing Plants		3,900,000 00
Real Estate (other than Manufacturing Plants):		
Edison Building, N. Y. City	$412,584 63	
Less mortgage thereon	200,000 00	
	212,584 63	
Other Real Estate	211,198 79	
		423,783 42
Stocks and Bonds (see Schedules A and B)		5,079,012 51
Cash	404,236 48	
Notes and Accounts Receivable	6,550,499 50	
Work in Progress	757,087 04	
		7,711,823 02
Inventories:		
At Factories	$3,046,014 59	
At Sales Offices (including consignments)	813,654 39	
		3,859,668 98
Sundry Debits		27,989 09
Profit and Loss		14,794,716 97
		$43,956,258 01

LIABILITIES.

Capital Stock:		
Common	$30,460,000 00	
Preferred	4,252,000 00	
		$34,712,000 00
Five Per Cent. Gold Coupon Debentures		8,750,000 00
Accrued Interest on Debentures	72,916 65	
Accounts Payable	421,341 36	
		494,258 01
		$43,956,258 01

CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1895.

Adjusted Balance as of January 31, 1895			$15,209,359 69
Business of the Current Year:			
Cost of Goods Sold	$9,557,327 69		
Legal and General Expenses and Taxes	1,894,536 29		
		$11,451,863 98	
Interest on Debentures		464,583 33	
			11,916,447 31
Losses Chargeable Partly to Frevious and Partly to Current Years' Business:			
Consignments and Contracts written off		134,772 96	
Additional Depreciation Allowed for:			
On Plants, Consignments and Contracts	177,417 50		
On Notes and Accounts Receivable	130,833 50		
		308.251 00	
		443,023 96	
Further Amounts now charged off:			
Patents and Franchises	162,298 11		
Various Inventories	288 401 14		
Sundry Losses	38,798 34		
		489.497 59	
			932,521 55
			$28,058,328 55
Business of the Current Year:			
Sales	12 540 395 12		
Royalties and Sundry Profits	420,818 17		
		12,961,213 29	
Interest and Dividends on Securities owned	187,946 81		
Interest and Discount	114.451 48		
		302,398 29	
			13,263,611 58
Balance, January 31, 1895			14,794,716 97
			$28,058 328 55

SUPPLEMENTARY CONSOLIDATED PROFIT AND LOSS ACCOUNT OF JANUARY 31, 1894.

Balance, January 31, 1894			$12,454,967 42
Losses Chargeable to Further Liquidation of Last and Previous Years' Business:			
Sundry Liquidation Accounts		$264,048 36	
Claims against Northwest General Electric Company		456,484 43	
On Account of Settlements with United Electric Securities Co. of Bond Transactions under Thomson-Houston Electric Co.'s Contracts		46,382 86	
Old Notes and Accounts Receivable wholly charged off		234 973 69	
Sales of Plants and Real Estate below book values		41,501 97	
			1,043,391 51
Special Allowance (see page 2)			2,000,000 00
			$15,498,358 73
Profits Belonging to Last and Previous Years' Business:			
Discount on Debentures purchased		$141,931 67	
Sales of Stocks and Bonds in excess of book values		147,067 37	
			288,999 04
Balance carried down			15,209,359 69
			$15,498,358 73

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, May 6, 1895.

THE PORTER STANDARD MOTOR COMPANY has removed its offices to 66-68 Broad street.

MR. WILLIAM TAYLOR, formerly of Taylor, Dee & Mack, Chicago, and for many years prominently identified with electrical interests, has accepted a responsible position in the business office of THE ELECTRICAL WORLD.

THE EDISON ELECTRIC ILLUMINATING COMPANY, by a considerably more than two-thirds vote required by law, has decided to issue $15,000,000 of 100-year 5 per cent. bonds. About $12,000,000 of this money will be used in retiring existing bonds of the parent company and of the Harlem and Manhattan Companies, which have been absorbed by it. The remainder of the proceeds will be expended in future construction and improvements.

THOS. A. EDISON'S bid of $125,100 for the entire assets and effects of the North American Phonograph Company was rejected by Chancellor Alexander T. McGill and instructions were given Receiver John R. Hardin to gather into one lot all the assets, including the stock of the Edison Phonograph Company and all the patents, and offer them in an entirely public sale. Mr. McGill stated that his decision in nowise reflected upon Mr. Edison, who he believed, had acted all through as a high minded, honorable man.

ELECTRIC THEATRE SIGNS.—The Bureau of Encumbrances has notified the managers of the Bijou, Casino, Miner's, Garden, Palmer's, Herald Square, Pastor's and other theatres to remove the electric advertising signs displayed in front of the play-houses outside of the stoopline in violation of the city ordinance. The signs will have to be remodelled and rehung to conform to the letter of the law, as they have proved too valuable as advertising mediums to be abolished. In addition they add greatly to the beauty of New York's night scenes.

BROOKLYN'S ALDERMEN last week had an exciting discussion over the electric light specifications, there being three separate resolutions before them. Alderman Clark's resolution, requiring the companies to furnish light at a price not exceeding 35 cents per lamp per night, and Alderman Walkley's, requiring them not to exceed 40 cents per night, were both voted down. Alderman Walsh's (which is alleged to have been prepared in the office of one of the old companies, and to practically debar the Edison Company from competition), after a stormy discussion, was laid over to the next meeting by a very close vote. Alderman Walsh's resolution appears to have some new features on the general subject. One of these proposes to allow the company interest on money due since Jan. 1 on the city's unpaid bills.

THE BOARD OF ELECTRICAL CONTROL last week approved the application of the American District Telegraph Company for subways in Eighth and Ninth avenues from Waverley place to 20th street; Eighth street, from University place to Third avenue; 14th street, from Broadway to Third avenue; 30th street, from Broadway to Seventh avenue, and 26th street, from Broadway to Fourth avenue. These subways will be built if the Commissioner of Public Works does not object to the streets named being torn up. Permits for subways were also granted to the Manhattan Electric Light Company, from 54th to 70th street, and to the Madison Square Electric Light Company on First avenue, from 28th to 42d street. The board departed from its usual rule and voted to tear up Fifth avenue in order that the Metropolitan Telegraph and Telephone Company may have subways in that avenue from 12th to 23d streets and from 42d to 57th streets. During his administration Mayor Gilroy refused to permit Fifth avenue to be disturbed for any such purposes. The request of the Brush Electric Light Company for permission to erect poles on Nassau street was referred to Commissioner Kearney.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 4, 1894.

MR. GEO. H. MILLS, of the New York Carbon Works, has been for several days a welcome visitor in and around Boston, holding old friends and making new ones.

WADDELL-ENTZ AFFAIRS.—Judge Robinson has ordered that the stock and machinery of the defunct Waddell-Entz Company be sold within two months. Receiver Hughes had reported that there was nothing to be gained by continuing the business.

MR. W. C. LANGFORD, of the late firm of Hutchings, Langford & Hutchings, Providence, R. I., has located in business for himself in that city at 174 Westminster street, where he will continue the business of electrical contracting, construction, supplies, etc. Mr. Langford has hosts of friends, all of whom wish him success.

UNDERGROUND WIRES.—The matter of putting wires underground is worrying the Brockton (Mass.) authorities. Those who are opposed to burying the wires are few, but those who disapprove the proposal of the telephone company to bury its wires in a conduit to be owned and controlled by it, are many in number and positive in opinion.

THE FOLLOWING ELECTRICAL ESTABLISHMENTS of Boston will close their places of business during the months of May, June, July, August and September at 1 o'clock Saturdays and 5 o'clock other days: Pettingell, Andrews Company, Holtzer-Cabot Electric Company, Anchor Electric Company, Gillis & Gleeson, Ziegler Electric Company, Thompson-Brown Electric Company and the Electric Gas Lighting Company.

DURING THE PRESENT WEEK, owing to the extremely warm wave that has prevailed, the West End Railway has had to run quite a number of open cars. In anticipation of its summer traffic the company has recently built and

purchased a large number of new cars. They are very handsome, commodious and comfortable, and the traveling public fully appreciates the progressive and enterprising policy of the company.

WORK IS BEING PUSHED on the new Subway, notwithstanding the frantic efforts of the opponents of the entire project to induce the legislature to put a stop to the work. Petitions have been gotten up in various forms. A motion was submitted in the House of Representatives, but the same was lost by a large majority. It is believed now that no further attempts will be made to obstruct the work. Hundreds of men are employed; many trees on the Common and in the Public Gardens have been cut down or removed, and piles are now being driven for the roadway at the southern entrance to the tunnel, which is near Park Square Station.

ELECTRIC POSTAL SERVICE IN BOSTON.—On May 1 the Post Office Department in Boston established the new trolley car service, which cannot fail to be of great advantage to the people residing in the suburbs. These cars were put into commission at 10 a.m., May 1, and the departure from Post Office Square attracted a good deal of public attention. The round trip of each car occupies about one hour, and the schedule on which they are running is so arranged that each car will leave the General Post Office hourly. Chutes are provided in the sides of each car for the reception of mail matter en route. As there is considerable car traffic through Post Office Square all day long, the West End Railway Company is laying a new track up Water street at north end of Post Office Building, where the cars can stand while discharging or loading the mail sacks. Should the service realize the expectations of the Railway Mail Service Department, other cars may be added for running to more remote districts.

THE ELECTRIC HEAT ALARM COMPANY, Boston, reports an excellent business in its varied line of manufactures and specialties. It is doing a nice business with manufacturing, hotel and general business interests through its admirable Automatic Fire Alarm and Journal Bearing systems, the application of which for marine purposes is also being rapidly recognized. Work is in progress equipping a new steamboat now building for the Marine Coast Navigation Company, Bath, Me. Its system has also been adapted to the "Hart Signal and Stop Engine" apparatus, which will hereafter be handled by this company. The system for stopping the engine is so arranged that a short circuit will not stop the engine, but simply ring a bell in the engine room, while breaking the glass in the box plainly marked "To Stop the Engine, Break the Glass," located on any of the floors in various sections of the building will cause immediate stopping of the engine. This, it is said, is the only apparatus that cannot be tampered with and thus cause a stopping of the engine needlessly. Mr. Hart, of the Hart Electric Signal Company, of Fall River, has installed quite an amount of this apparatus and it is giving good satisfaction. The Electric Heat Alarm Company is also receiving extraordinary demands for the "Simplest" Cleat, one of its recent specialties.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
May 4, 1895.

GEO. CUTTER has pleased the trade once more with a neat bit of literature on "Cutter's Electric Street Lighting Specialties," having all his latest, 1895, devices illustrated. It is especially interesting.

SUNBEAM LAMPS are now being turned out nearly 6,000 a day. The company is making it known that it has a good lamp, consequently the cheapest lamp, though not the lowest priced lamp in first cost. There seems to be a great change of sentiment to this new doctrine, and the "Sunbeam" seems to be well to the front.

IT IS UNDERSTOOD that in selecting the incandescent lamps for the new Steinway Hall, several types were submitted to a severe test under the direction of the architect, and that the Columbia, manufactured at St. Louis, was awarded the contract on the point of superiority. At the same time it is whispered that architects and contractors are about to inaugurate a series of efforts to determine ahead of time just which is the best lamp to buy.

General News.

ELECTRIC LIGHT AND POWER.

ROPER CITY, N. C.—Steps are being taken to establish an electric light plant.

GLENS FALLS, N. Y.—An electric lighting system is to be installed here in the near future.

WEST RANDOLPH, VT.—Steps are being taken to establish an electric light and power plant.

ONARGA, ILL.—J. B. Owen has been granted a ten-year franchise for an electric lighting plant.

HEMPSTEAD, L. I., N. Y.—It is reported that this place is to be lighted by electricity in the near future.

GLENWOOD, MINN.—It is reported that an electric lighting system is to be installed in this village in the near future.

KNOXVILLE, TENN.—An electric lighting plant is to be built here by the East Tennessee Marble Producers' Company.

RED WING, MINN.—It is reported that a fire-proof addition is to be built to the St. James Hotel. Electric lighting will be introduced.

WOODRIDGE, N. J.—It is reported that electric street lighting is to be introduced. Address the clerk of the Borough Council for particulars.

CHERAW, S. C.—An electric lighting plant is to be installed in the Cheraw Knitting Mills. Bids for the construction of same will be received.

STEPHENVILLE, TEX.—The erection of an electric lighting plant at this place is contemplated. The clerk of the City Council can give particulars.

LYNBROOK, L. I., N. Y.—The establishment of an electric lighting system at this place is contemplated. The Village Improvement Society is interested.

GREEN ISLAND N. Y.—A bill has been passed authorizing the installation of an electric lighting system in this village. The clerk of the Council can give further details.

TECUMSEH, MICH.—The streets of this village are to be lighted with electricity in the near future. W. J. Ingersoll is village clerk and can furnish detailed information.

NEW YORK CITY.—The Gerlach Hotel, located at 49-53 West 27th street, is to be enlarged at a cost of $200,000. The structure is to be equipped with all appliances for electric lighting.

BARDSTOWN, KY.—The erection of an electric lighting plant is contemplated by the city authorities at an estimated cost of $7,500. Orville Arnold can be addressed for further particulars.

CASCADE, IA.—At a recent election it was decided to erect a new electric lighting plant. The work of construction will commence at once, and the clerk of the Council can give detailed information.

MOOREHEAD, MINN.—The City Council, at a recent special meeting, decided to build an electric lighting plant at this place. Bids will be received until May 12, and the clerk of the Council can furnish detailed information.

CHATTANOOGA, TENN.—Bids will be received until June 3 for the construction of a municipal electric lighting plant with a capacity of 3,200 arc lights and 100 incandescent lights. O. S. Martin, chairman of the lighting committee, can be addressed.

MECHANICSBURG, PA.—Sealed proposals will be received until 12 o'clock noon May 23, 1895, for the lighting of the streets of the borough of Mechanicsburg, Cumberland County, Pa., by electricity, for one year, with the privilege to the town of renewing the contract for two years. J. S. Huston is chairman of the light committee.

SEATTLE, WASH.—The Union Electric Company has recently been formed for the purpose of leasing the properties of the Union Electric Company and the Seattle Gas & Electric Lighting Company. The arc light station formerly operated by the gas company will be discontinued. The offices have been consolidated in the rooms formerly occupied by the Union Electric Company. Dr. R. C. Kilbourne, formerly general manager of the Union Electric Company, continues in the general management of the consolidation.

THE ELECTRIC RAILWAY.

OCEAN VIEW, VA.—An electric railway is to be built at a cost of $250,000.

MANCHESTER, N. H.—Soulle, Dillingham & Co. are pushing forward the electric road.

HAZELTON, PA.—The Traction Company will shortly lay tracks to run east on Spring street.

PITTSBURGH, PA.—Messrs. Oliver Bros. have petitioned for a franchise for an electric railway.

PORTSMOUTH, VA.—An electric railway is to be constructed from Portsmouth to Port Norfolk.

NASHUA, N. H.—Work on the track of the electric railway will be at once commenced in Hudson.

BRUNSWICK, GA.—A franchise has been applied for by J. E. Du Vignon to construct an electric railway for this place.

LOWER PROVIDENCE, PA.—The Norristown & Perkiomen Railway Company has applied for right of way into this place.

CARTHAGE, N. Y.—Steps are being taken to build an electric road from this company to Copenhagen, a distance of eight miles.

PIKEVILLE, MD.—The Pikesville, Reistertown & Emory Grove Electric Company expect to have their line complete about May 1.

TOWANDA, PA.—The Towanda Traction Company has been granted an extension of three months in which to complete its road.

BAY SHORE, L. I., N. Y.—The Brentwood Trolley Railway Company has been granted a franchise to construct their line through this place.

PORTLAND, ME.—Work has been commenced on the erection of the new electric power house for the Portland Street Railway Company.

TAMPA, FLA.—The Consumers' Street Railway Company has purchased the Palmetto Beach Railway, and will extensively improve and extend the system.

BINGHAMTON, N. Y.—The Binghamton, Lestershire & Union Railway Company will extend its line. Address Manager J. E. Clark for detailed information.

WASHINGTON, D. C.—Work has been commenced by the Washington & Mt. Vernon Electric Railway Company on the construction of its underground railway.

WARREN, MASS.—The Warren, Brookfield & Spencer Electric Railway Company has applied for a franchise. Address I. L. Currier for further information.

CHATTANOOGA, TENN.—Surveys are being made for an electric line to be constructed from Rossville to Chickamauga Park. John R. McFarland is general manager.

CAMDEN, N. J.—A crosstown trolley line is to be erected on Second and Third streets from Kaighn to Erie street, by the Camden Horse Railway Company.

VERSAILLES, PA.—It is reported that the Versailles Electric Street Railway Company will extend its line to Scotthaven and West Newton, a distance of eight miles.

NEW HAVEN, CONN.—The New Haven Street Railway Company has applied for permission to extend its line on Townsend avenue from Four Corners to Morris Cove.

SAGINAW, MICH.—It is reported that two electric railways are to be built between this place and Bay City. Address the Rapid Transit Company for detailed information.

SUSQUEHANNA, N. Y.—The construction of an electric railway between

this place and Lanesboro is contemplated. Address the clerk of the Council for detailed information.

BROOKLYN, N. Y.—The Brooklyn & Brighton Beach Railway Company has been granted permission to construct a connecting line with the Kings County Elevated Road.

FAIR HAVEN, CONN.—The Fair Haven & Westville Railway Company will extend its line to Montowese. The extension will be 3¼ miles in length and work will be commenced in the near future.

SPENCER, MASS.—The Warren, Brookfield & Spencer Railway Company has petitioned for a franchise for right of way through the streets of this town. R. L. Courier and C. O. Richardson are among the directors.

PIERMONT, N. Y.—The Nyack Traction Company has petitioned for permission to construct, operate and maintain an electric street railway through this village. C. H. Kane, town clerk, can furnish further details.

COLUMBUS, GA.—It is reported that the Columbus and Rome narrow guage railroad is to be changed to standard guage and extended to Atlanta. The road will be operated by electricity. Grisby E. Thomas, Jr., is interested.

NEW YORK, N. Y.—The Flushing & College Point Electric Railway Company has been sold to Cravath & Houston, representing the reorganized company, for $25,000. The new company will operate the road and improve its facilities.

BUFFALO, N. Y.—The Buffalo & Gardenville Electric Railway Company will soon be incorporated with a capital stock of $40,000, to connect Gardenville and Ebenezer by an electric line. The route will be from Seneca street to Winchester avenue (Indian Church road), thence to Gardenville and to Ebenezer. The road will be double track, and the work of construction will be begun as soon after incorporation as possible.

Personal Notes.

LIEUT. J. B. CAHOON on May 1 severed his connection with the General Electric Company to take the position of general manager of the Elmira Municipal Improvement Company, which owns the water, gas and electric lighting plants, and the principal electric railway of Elmira. Lieut. Cahoon made an enviable record with the Thomson-Houston and General Electric Companies, his organizing abilities having been of particular service to the former in connection with the organization of the different departments at Lynn, while his successful conduct of the expert departments and students' courses of both companies showed that he also possesses executive talents of a high order. The recent duty of Lieut. Cahoon in inspecting and reporting on lighting and street railway plants in which the General Electric Company has an interest will be especially useful to his present employers, who are to be congratulated upon having secured the services of one so thoroughly competent to take charge of their extensive interests.

MR. CHARLES T. SNEDEKER, the inventor of "Salamander" wire, returned to New York on May 1, after a trip of 14 months through England, Germany, Russia, Hungary, Austria, Italy and France, where he visited the more important central stations and the works of the largest manufacturers of electrical machinery and insulated wire. Mr. Snedeker has been successful in selling his patents and starting the manufacture of "Salamander" insulated wire in the works of Messrs. Felten & Guilleaume, at Cologne, Germany, and also at Vienna and Budapest. The French patent he sold to the Societe Industrielle des Telephones at Paris, which is the largest wire and cable manufacturing company in France. This company has bought the Rutier and Menier Works, and has just completed the new cable between Madagascar and the main land. Mr. Snedeker reports that "Salamander" wire has been ordered in all the French arsenals, power magazines and government store houses where electric light is used, as well as in many theatres and libraries.

Miscellaneous Notes.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS announces that the annual meeting for the election of officers, reception of reports, and transaction of other business of the institute will be held at 12 West 31st street, New York City, Tuesday evening, May 21, instead of May 14, as previously announced on the balloting circulars. At the same meeting the discussion of Prof. Anthony's paper will be resumed, and it is expected that a paper will also be presented by Mr. A. D. Adams, of Boston, on "The Most Economical Form for Bipolar Field Magnets."

ELECTRIC LEAGUE NO. 1 OF AMERICA was incorporated in New York last week and held its first meeting on May 1, at Third avenue and Sixteenth street. There was an attendance of about 300, and interesting addresses were made by Colonel Taliaferro, Prof. S. S. Wheeler and Mr. DeGuerro. The object of the League is to elevate the standard, morally and mentally, of electrical workmen and the general advancement and education of its members. The organization will be conducted on conservative, but broad gauge principles, and it is proposed to establish branch leagues in other cities. The Electric League starts out with fine prospects and has the unqualified approval of some of the most prominent persons connected with electrical interests. The officers for the first year are George Porter, president; Louis W. Dillman, recording secretary; John S. Rockefeller, financial secretary; William A. Slack, inside sentinel; John C. Scott, outside sentinel.

TELEGRAPHIC HISTORICAL SOCIETY.—A meeting of the Telegraphic Historical Society was held in Washington on May 1. The society was organized last year through the efforts of Mr. Geo. C. Maynard, and has now a membership of 265. Several interesting papers were read, one by Mr. Henry A. Reed on "The Paternity of the Telegraph," the author of which had played a prominent part himself in the early days of telegraphy, and had been associated with Prof. Morse in some of his early experiments. Mr. T. D. Lockwood also read a paper on the early history of the telegraph. The following officers were elected for the ensuing year: President, Alonzo B. Cornell, Ithaca, N. Y.; first vice-president, S. H. Kauffmann, Washington, D. C.; second vice-president, Wm. B. Wilson, Philadelphia, Pa.; third vice-president, Thomas D. Lockwood, Boston, Mass.; secretary and treasurer, Geo. C. Maynard, Washington, D. C.; members of executive council, J. H. Emerick, New York City; B. F. Dillon, Jacksonville, Fla.; Wm. R. Plum, Chicago, Ill.; J. Q. Mason, Tacoma Washington.

THE ELECTRIC POTENTIAL CLUB, Boston, held its annual meeting and dinner at Young's Hotel, on Tuesday evening, April 30, with 30 members present, and the various branches of the electrical industry of Boston well and prominently represented. At the conclusion of the dinner President C. W. Holtzer presented seven names for membership, all of whom were elected. The following officers were then elected for the ensuing year: President, Frank Ridlar; vice-presidents, Col. E. H. Hewins and George W. Blodgett; treasurer, I. H. Farnham and secretary Sidney Hosmer. President Holtzer was renominated, but declined the honor. Treasurer I. H. Farnham submitted his report, which showed no outstanding debts, something in the treasury, and a paid membership of 35. Reference was made in the report to the death of Mr. Samuel G. Sturess, of Pawtucket, R. I., to which subsequent allusion was made by Mr. R. F. Ross in fitting terms, and a committee was appointed to draft resolutions of sympathy to his family. Following the business meeting, Mr. D. N. Bliss, of the Holtzer-Cabot Electric Company, delivered an interesting address upon "Automatic Insulation, High Potential Apparatus, Controlling of Currents, etc." Apparatus was in position in the room to illustrate the lecture, but owing to the inability to get the alternating current supplied it was not in operation, much to the regret of all present. The discussion which ensued, by Prof. Puffer, Mr J. M. Oxford, Mr. I. H. Farnham and others, was decidedly instructive. The meeting was a success in every respects, and a vote of thanks tendered Mr. Holtzer, through whose efforts the organization was brought into existence, for the hard work he has done against many obstacles, in holding it together.

Trade and Industrial Notes.

GEO. F. WOOLSTON, JR., 40 Wall street, New York, will make purchases for machinery and material for a complete electric light plant for Guayaquil, Ecuador, S. A.

THE NEWTON ELECTRICAL COMPANY, New York, has sold all its property to Walter Boardman, of Lancaster, Pa., who is considering the feasibility of reorganizing the business.

DOUBLEDAY, MITCHELL & CO. have removed their offices from 136 Liberty street to the Thames building, corner of Thames and Greenwich streets, New York, where they occupy rooms 101, 102, 103.

CHAS. E. CHAPIN'S numerous friends were greatly distressed by the news of his assignment last week. Mr. Chapin is an energetic, conscientious business man, and it is sincerely hoped that he will soon be on his feet again.

JULES GERAUD & LECLERC, patent attorneys, of No. 48 Rua do Rosario, Rio de Janeiro, Brazil, are sending out circulars containing explicit information for the guidance of patent agents having South American patent work to be executed.

PIERCE & MILLER, lately at 42 Cortlandt street, New York, are now occupying new and commodious offices in the Havemeyer Building, 26 Cortlandt street. They will continue to conduct a business of the same general character as heretofore.

THE COTTON STATES & INTERNATIONAL EXPOSITION COMPANY, Atlanta, has issued a prospectus setting forth the objects and scope of the exposition, and describing in detail the various buildings, etc. A map of the grounds is contained in the circular.

THE BALL & WOOD COMPANY, engine builders, of New York, represented in Chicago by C. E. Sargent, will remove its Chicago offices on May 1 to 404 Fort Dearborn Building, where Mr. Sargent would be very glad to see all his acquaintances.

THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA, Monadnock Block, Chicago, has published a circular setting forth the merits of its direct-connected, continuous current apparatus, and giving figures to show the relative efficiency of alternating and continuous current systems, belted and direct driven.

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., is putting up an iron bridge at Thomaston, Conn., consisting of two plate girder spans, each 60 ft. long, with a roadway 22 ft. wide, and two sidewalks, each 6 ft. wide. The bridge will be made entirely of iron and concrete, no woodwork being used in the construction.

THE HORNBERGER ELECTRIC MANUFACTURING COMPANY, of Elkhart, Ind., has opened a branch office at 136 Liberty Street, New York, with Mr. E. B. Latham in charge as eastern manager. Mr. Latham was employed by the T.-H. and General Electric companies in different important positions for twelve years previous to his association with the Hornberger Company.

THE MASON TELEPHONE COMPANY, 3 Governor street, Richmond, Va., has secured the contract for a 250-wire telephone exchange at Petersburg, Va., one of 100 wires at Greenville, Tex., and one of 60 wires at McKinney, Tex. The Mason Company has also in course of construction an exchange at Bryan, Tex., and one at Anderson, S. C. The company wishes prices on poles, wires, brackets, insulators, etc, delivered at Petersburg, Va.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is getting a large share of the telephone supply business, which just at present constitutes a very considerable part of the demand for electrical supplies. The fact that the company carries on hand a very large stock of telephone line material, such as cross arms, insulators, etc., and can ship almost any kind of an order promptly from Chicago, gives it a valuable advantage which counts for a great deal in the telephone business.

THE AUTOMATIC SWITCH COMPANY, of Baltimore, Md., recently shipped to its Boston representative, the Boston Electric Company, a 85-hp, 500-volt, Whittingham automatic motor starter, which is probably the largest self-contained device of the kind ever constructed. The dimensions of the rheostat are 7 x 12 x 18 inches, but notwithstanding the small space occupied, the radiating surface is said to be over 8,100 square inches. The weight of the complete starter is about 900 pounds.

THE LOUISVILLE ELECTRICAL WORKS, of Louisville, Ky., reports already a most gratifying demand for its Phœnix transformers, described recently in THE ELECTRICAL WORLD, and in order to keep up with orders the factory is running nights. Such a prompt acknowledgement upon the part of the public of the merits of the transformer was not entirely anticipated, and consequently the company was unprepared for the rush of business, but it is now in position to take care of all orders promptly.

THE SCOTT ELECTRIC LAMP COMPANY, 126 Liberty street, New York, reports the following remarkable adventure of a Huntingdon search light. In January last, just prior to the sailing of the ill-fated "City of Haverhill," the Scott Company installed on her a Huntingdon search and position lamp. The pilot boat "James Gordon Bennett" recently found the lamp attached to the roof of the "Haverhill's" pilot house, floating around some 100 miles off Sandy Hook. The lamp is now on exhibition in the Scott Company's office.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York, has published its seventh illustrated catalogue of electrical supplies, and the book is very complete and exceedingly well gotten up. The paper is good, the cuts clear and sharp, and the contents logically arranged. The line of goods advertised is comprehensive, embracing telegraph and telephone instruments and supplies, gas lighting and medical apparatus, annunciators, burglar alarms, electric bells, electric light supplies, etc., etc.

THE BALL & WOOD COMPANY'S works at Elizabeth, N. J., present a scene of great activity just now. The company has orders ahead for a good many engines for both eastern and western points, and the new western agent, Mr. Sargent, has just obtained a contract for several cross-compound engines for the new Milwaukee city hall. Ball & Wood engines are now being installed in the Temple of Music, Grace Hotel, Fort Dearborn building and for Messrs. Morgan & Wright, Chicago. In St. Paul the Ball & Wood engine recently placed in the Manhattan building is attracting very favorable attention. This engine is directly connected with a Western Electric dynamo, and runs smoothly and noiselessly, and with very close regulation. In New York the list of recent sales of Ball & Wood engines embraces the equipment of the new St. Luke's Hospital, on the Heights of Morningside Park; a second engine for the 42d street house of the Manhattan Storage Warehouse Company; several engines for the new Syracuse station of the New York Central Railroad. Messrs. Stoutenburgh & Co., of Newark, are also putting in two of these engines, and the Danbury & Bethel Railway Company, of Danbury, Conn., is having a second 42-hp cross-compound built.

JAMES G. BIDDLE, who, for some five years past, has been manager of the electrical department of Queen & Co., has recently opened an office at 525 Drexel building, Philadelphia, as dealer and manufacturers' agent for scientific and electrical apparatus. As sole American agent Mr. Biddle represents Elliott Bros., of London, which firm is perhaps more widely known throughout the world than any other makers of scientific instruments. In addition to electrical measuring apparatus, for which they are chiefly noted, the Elliotts manufacture telegraph instruments of the highest order, chronographs and other recording instruments, engineering instruments, standards of length, micrometers, cathetometers, optical instruments, etc. They have largely supplied the various English home and colonial departments, numerous foreign governments, London Board of Trade, London City Council, the principal colleges and universities everywhere, all of the submarine cable companies, and many of the important standardizing laboratories. The last extensive exhibit of their instruments was at Paris in 1889, where they received the only "Grand Prix" accorded to any English electrical exhibit. To make the line of electrical instruments complete, Mr. Biddle has arranged with the Weston Instrument Company, of Newark, to handle its portable and switchboard voltmeters, ammeters, wattmeters, etc., as special agent, so that he is in a position to execute orders of any size at bottom factory prices. Mr. Biddle is also selling agent for the Electric Storage Battery Company, and is making a specialty of the "Chloride" accumulator for college and laboratory work. Full particulars are set forth in a catalogue recently issued which describes batteries of all sizes and for all purposes, including cells mounted in portable hard wood cases for phonographs, kinetoscopes and other small motor work.

Business Notice.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENT ISSUED APRIL 28, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

538,158. ELECTRIC RAILWAY SYSTEM; J. M. Faulkner, Philadelphia, Pa. App. filed Jan. 12, 1895. In an underground electric railway system, an exposed conductor having rigid contact points in the conduit, vertically movable bodies of magnetizable material in the conduit and connected electrically with the live wire, each body having a vertical opening, a cup set beneath the opposite conductor contact and containing mercury, and an upwardly extending insulating guide surrounding the contact

UNITED STATES PATENTS ISSUED APRIL 30, 1895.

538,248. CHANGEABLE ELECTRIC HEADLIGHT; W. Dibb and F. C. Rorabeck, Syracuse, N. Y. App. filed March 19, 1894. The combination of a contact board, spring fingers normally in circuit with wires connected to them, a second negative pole upon the said board and a reflector stem adapted to break the circuit through the said fingers, and make it through the positive pole of said circuit and a lamp attached to the said poles.

538,247. ELECTRICAL SIGNALING SYSTEM; B. A. Fiske, United States Navy. App. filed Dec. 20, 1894. In an electrical signaling apparatus, a conductor in circuit, and at a distant station an indicating instrument having its terminals electrically connected by line to two points on said conductor, one of which is movable and the other fixed on each side of the fixed terminal, causing the index of said indicating instrument to move in a direction corresponding to the movement of the movable terminal, and over a distance depending upon the fall of potential on the conductor between said terminals.

538,271. ELECTRICALLY AND CHEMICALLY HEATED CRUCIBLE; H. G. O'Neill, Boston, Mass. App. filed March 24, 1894. A crucible, with electrodes contained therein, electrical circuit connections to the said electrodes and a mixture of earth and carbonaceous material interposed between the said electrodes.

538,272. ELECTRICAL CIGAR LIGHTER; H. G. O'Neill, Boston, Mass. App filed Aug. 27, 1894. A hollow handle in combination with circuit conductors extending within the same, springs to which the said conductors are attached, terminals arranged to cause such contact on the depression of a button.

538,275. ELECTRICAL BRAKE; C. E. Pearson, St. Louis, Mo. App. filed April 2, 1894. The combination with a moving element, a core provided with a polar extension, coils on the core, each of which magnetizes the polar extension to different degrees, means for energizing the coils separately and in succession to magnetize the polar extension to a lesser degree at first, and increasing the intensity as the coils are successively cut in, and means for cutting in the current to all of the coils at once.

538,281. BRUSH HOLDER; E. D. Priest, Lynn, Mass. App. filed Aug. 25, 1892. The combination of a stationary part, two elbows, levers fulcrumed thereon, adjustable springs bearing against the said levers stop to limit their movement, spring arms attached to the levers, and a socket piece pivotally connected with the outer ends of the said arms.

538,284. THERMAL CUT-OUT DEVICE; C. A. Rolfe, Chicago, Ill. App. filed Feb. 21, 1895. The combination of a body of fusible material, a section of circuit conductor removably held in circuit and comprising a wire of high resistance in part coiled within the fusible mass and a holder for the wire having contacts with which the wire is connected, and a spring normally held in tension by the fusible mass and arranged to throw the movable section of the circuit conductor away from its co-operating contacts and out of circuit when it is released by the fusion of the mass of fusible material.

538,289. MANUFACTURE OF CARBON FOR ELECTRICAL PURPOSES; C. P. Shrewsbury, London, England, and J. H. Dobell, Modbury, Eng. App. filed Sept. 10, 1894. The combination of combining certain ingredients, heating and then forming or shaping into carbons for electric lamps.

538,295. TROLLEY; J. D. Swacick, Canton, O. App. filed Oct. 22, 1894. The combination of a supporting frame, spindles secured thereto, a wheel composed of two parts, one part being provided with an oil chamber having a screw edge, and the other part having a thread edge to take the threaded edge of the chambered part, and a set screw for the double purpose of preventing the two parts of the wheel from unscrewing, and to afford means for allowing a lubricant to be introduced into the chamber.

538,320. MAGNETIC ORE SEPARATOR; J. W. Carter, Brooklyn, N. Y. App. filed Dec. 30, 1893. The combination of a supply hopper, a series of permanent magnets, the pole ends of which are located below the hopper, and an adjustable deflecting plate located above and at a short distance back of the pole ends of the magnets in the path of the falling material.

538,325. MEANS FOR VENTILATING ELECTRIC MOTORS ON CARS; J. J. Devine, Clifton Heights, Penn. App. filed March 14, 1895. The combination with the motor box in a car of a conduit arranged in the under part of the car, and provided at its ends with caps which may be opened or closed as desired, and flexible connections between the pipe and the lids of the motor box, and opening from the motor box into the main pipe.

538,327. TELEPHONE CENTRAL OFFICE SYSTEM; E. T. Gilliland, Pelham Manor, N. Y. App. filed June 5, 1894. In a switchboard, the combination of a spring jack comprising two normally united but separable contact pieces, forming respectively the terminals of the direct and return circuit conductors, and a third contact point insulated from the others, connected with that conductor which includes the call annunciator at a point external to the annunciator, the mouth of the spring jack being sufficiently capacious to admit of two plugs therein at once.

538,328. MAGNETO TRANSMITTER; E. T. Gilliland, Pelham Manor, N.Y. App. filed June 5, 1894. A transmitter having pole pieces hinged to the poles and in contact therewith, being mounted on a non-magnetic bolt and separated from each other by a non-magnetic tongue.

538,329. MAGNETO GENERATOR; E. T. Gilliland, Pelham Manor, N. Y. App. filed Nov. 28, 1894. A generator consisting of a magnet, pole pieces and a bracket in one casting, a driving shaft supported in the bracket, driving mechanism, an armature with bearings mounted between the pole pieces, and a clamping screw for clamping the bearings and holding them in position.

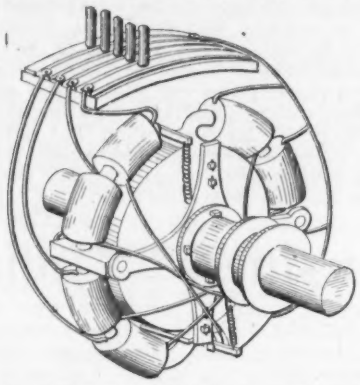
538,344. ARMATURE FOR DYNAMOS AND ELECTRIC MOTORS; H. Pennand L. Lowndes, London, Eng. App. filed Aug. 13, 1894. In armatures of dynamos and electric motors corrugated sheet discs comprising the armature being suitably separated from each other.

538,345. DYNAMO-ELECTRIC MACHINE OR ELECTRIC MOTOR; E. H. Porter, Radford, Va. App. filed Aug. 11, 1894. A dynamo or motor consisting of a single magnetic frame having six pole pieces with coils and armatures embraced therein in such relation that each has a four-pole field.

538,351. ELECTRIC ENGINE; L. M. Sabin, Washington, D. C. App. filed April 27, 1894. The combination of a compound tubular magnet, having independent coils and means for commutating an electric current through the same, of an electro-magnetic armature having a spool of non-magnetic material wound with a conducting coil, and conductors whereby the coil may be connected with a source of electrical energy.

538,357. UNDERGROUND ELECTRIC RAILWAY; J. F. Smith, New York, N. Y. App. filed Aug. 15, 1894. A carriage for the contact brushes consisting of a frame provided with longitudinal bars having angular deflectors at the ends and plates fastened between said bars having upwardly extending portions provided with means for attaching the carriage to the car.

538,378. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS; F. H. Homan, Brooklyn, N. Y. App. filed April 24, 1894. A conduit having at intervals exposed portions, a conductor suspended by a lever, a return conductor also enclosed in the conduit, and a transmitting trolley running on the conductor to supply current from the conductor to a motor, and a trailing trolley for returning the current from the motor to the return conductor.



No. 538,275.—Electrical Brake.

538,377. ELECTRIC ELEVATOR; N. O. Lindstrom, Union Course, N. Y. App. filed Feb. 26, 1895. The combination of a driving electric motor, a controller on the car, a motor rheostat for graduating the speed, an auxiliary reversely wound field magnet coil adapted to be cut into circuit, and a variable resistance for graduating the effect of the auxiliary coil.

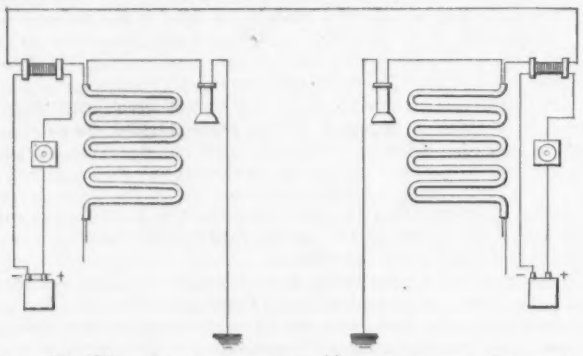
538,390. TROLLEY BREAKER; W. R. Scott, Buffalo, N. Y. App. filed Dec. 19, 1894. A hanger provided with a pair of upright ears separated by a space which receives the end portion of the wire, a rear pin connecting the ears, around which the wire is bent, and a front pin also connecting the ears and bearing upon the bent end of the wire.

538,391. TROLLEY WIRE HANGER; W. R. Scott, Buffalo, N. Y. App. filed March 5, 1895. A hanger provided with a seat for the trolley wire having a pair of cams pivoted to the body above the seat, the latter having a locking device.

538,408. ELECTRIC TRANSMISSION WHEEL OR TROLLEY; C. C. Burton, Pittsburgh, Pa. App. filed Aug. 11, 1894. A wheel having a rigid rim with a series of yielding contact blocks mounted in it, a separate current collecting plate within the rim with which the blocks make contact, and a conductor extending from the annular plate to the wheel hub.

538,417. MAGNETIC ORE SEPARATOR; J. Houlehan, Chicago, Ill. App. filed June 6, 1894 The combination of a movable magnet and an armature forming an interposed ore passage to separate the ores when passing.

538,423. ELECTRICAL COUPLING; M. F. Koenig and I. Mann, Hazleton, Pa. App. filed Oct. 15, 1894. A coupling consisting of a female portion with enlargement and binding screws and a flat hollow extension, and the male portion with enlargement and binding screws also, and an integral spring tongue bent upon itself twice, and its free end curved and formed with a lug stamped therefrom.



No. 538,474.—Apparatus for Transmitting Speech.

538,454. TELEPHONE SWITCH; A. F. W. Meyer, Blue Island, Ill. App. filed Jan. 11, 1895. The combination of a base carrying the main line terminals, yielding contacts connecting said terminals to the main line or to the ground, respectively, through the secondary winding of the induction coil and the signaling instrument circuit, a non-conductive lever switch provided with a support for the receiver and extending at one end between the contacts so connecting the main line terminals, and its opposite end adjacent to the contact connecting the local battery terminal, whereby the turning of the said lever in either direction forces one contact against an adjacent main line terminal and releases the other from the terminal adjacent to it.

538,457. ELECTRIC ARC LAMP; J. A. Mosher, Chicago, Ill. App. filed Feb. 9, 1893. A lamp having the poles of an electromagnet; a rotatable armature mounted between the said poles, the armature consisting of a number of plates successively overlapping each other; devices for supporting the lower carbon pencil; a vertically movable carbon rod adapted to support the upper carbon pencil over the lower pencil, and devices connecting the rotatable armature with the carbon rod in such a way that the length of the arc may be regulated by the rotation of the armature.

538,458. RAIL CONNECTOR; L. E. Myers, Chicago, Ill. App. filed Dec. 19, 1894. The combination of a connecting wire, and split sleeves adapted to receive the wire and to be driven into the holes in the rails, the sleeves being provided at one end with projecting parts which may be turned outwardly against the rail to prevent withdrawal of the sleeves from the holes in the rails.

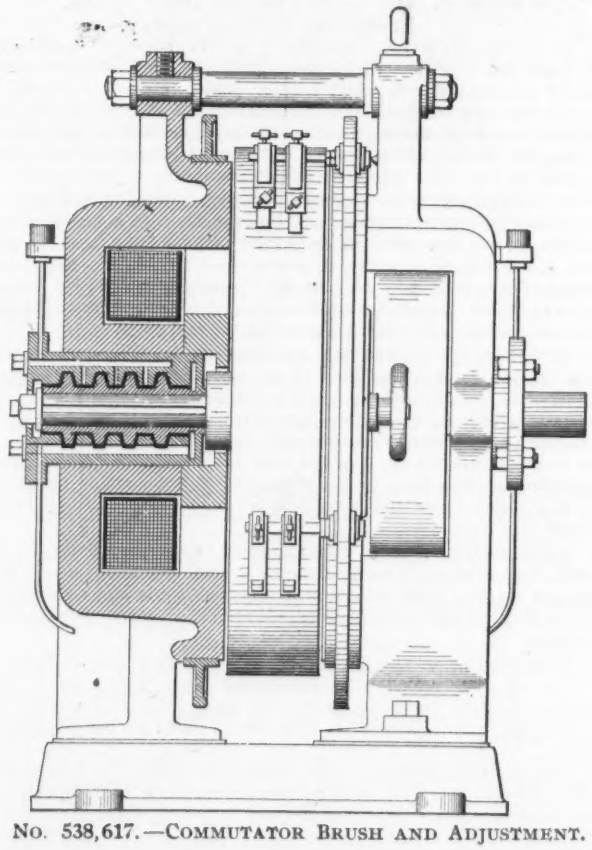
538,474. ART OF AND APPARATUS FOR TRANSMITTING SPEECH; J. Absterdam, New York, N. Y. App. filed Feb. 18, 1891. A line for electric telephone transmission formed in two or more "open circuit" sections extending adjacent to one another at their ends, but at all times disconnected from one another and from the ground during transmission, so as to be incapable of use for telegraphic service, or for sending calls from one section to another.

538,569. TROLLEY POLE RESTRAINER; F. Wheeler, Meriden, Conn. App. filed Feb. 8, 1895. A restrainer comprising a tube containing a movable head having detents and a spring connected with the head, the head als having means extending outside of the tube for enabling it to be moved by hand, and also means at each end of the car to hold it in place.

538,590. BLOCK SYSTEM AND APPARATUS ON ELECTRIC RAILWAYS; E. Lang, Cologne, Germany. App. filed July 16, 1894. The combination of a contact conductor divided into sections, an auxiliary contact conductor divided into sections, an auxiliary contact conductor divided correspondingly, a switch on each contact conductor section adapted to be moved by a passing vehicle, and an electromagnet on each auxiliary conductor section adapted to move the switch of the preceding section, so as to put this into circuit again when the said auxiliary conductor section receives current.

538,614. INSULATING MATERIAL; J. W. Kidwell, Washington, D. C. App. filed Sept. 8, 1894. An insulating material composed of different compounds adapted to prevent contact wherever it is applied.

538,617. COMMUTATOR BRUSH AND MEANS FOR ADJUSTING SAME; R. Lundell, Brooklyn, N. Y. App. filed July 20 1893. In a generator or motor, the combination of an annular body having pins extending therefrom and upon which the holders for the commutator brushes are mounted, and another annular body having projections adapted to move in the path of the brushes and so cause them to be shifted.



No. 538,617.—Commutator Brush and Adjustment.

538,628. METHOD OF MAKING ELECTRODES FOR SECONDARY BATTERIES; W. L. Silvey, Dayton, O. App. filed Jan. 28, 1893. The method of preparing at one operation a positive and a negative secondary battery electrode, consisting in applying a paste composed of water and oxide of lead to form the negative plate, and a paste composed of sulphuric acid and water to form the positive plate, and then pickling the two sets of plates in an acid solution.

538,803. LIGHTNING ROD; H. Simpson, Burlington, Wis. App. filed March 2, 1895. A rod tubular at its lower end and closed at its upper end, an opening or cup arranged adjacent to the said rod to divert the water into the opening and so conduct it into the ground.